INSTALLATION MANUAL

R-410A
ZH SERIES

6-1/2 - 12-1/2 Ton

60 Hertz

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General

York® Predator® units are single package air conditioners with optional gas heating designed for outdoor installation on a rooftop or slab and for non-residential use. These units can be equipped with factory or field installed electric heaters for heating applications.

These units are completely assembled on rigid, permanently attached base rails. All piping, refrigerant charge, and electrical wiring is factory installed and tested. The units require electric power, gas supply (where applicable), and duct connections. The electric heaters have nickel-chrome elements and utilize single-point power connection.

Safety Considerations

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention the signal words **DANGER**, **WARNING** or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury.**

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury.**

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

⚠ CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state and national codes including, but not limited to building, electrical, and mechanical codes.

⚠WARNING

Before performing service or maintenance operations on unit, turn off main power switch to unit. Electrical shock could cause personal injury. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

⚠ CAUTION

This system uses R-140A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system. Gage sets, hoses, refrigerant containers and recovery systems must be designed to handle R-410A. If you are unsure, consult the equipment manufacturer. Failure to use R-410A compatible servicing equipment may result in property damage or injury.

⚠WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

a. Do not try to light any appliance.

b. Do not touch any electrical switch; do not use any phone in your building.

c. Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.

d. If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Due to system pressure, moving parts, and electrical components, installation and servicing of air conditioning equipment can be hazardous. Only qualified, trained service personnel should install, repair, or service this equipment. Untrained personnel can perform basic maintenance functions of cleaning coils and filters and replacing filters.

Observe all precautions in the literature, labels, and tags accompanying the equipment whenever working on air conditioning equipment. Be sure to follow all other applicable safety precautions and codes including ANSI Z223.1 or CSA-B149.1- latest edition.

Wear safety glasses and work gloves. Use quenching cloth and have a fire extinguisher available during brazing operations.

Inspection

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing.

⚠ CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state and national codes including, but not limited to, building, electrical, and mechanical codes.

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG

Reference

Additional information is available in the following reference forms:

- Technical Guide - ZH078-150, 036-21692-001-A-0805
- General Installation - ZH078-150, 164015-YIM-A-0905
- Pre-start & Post-start Check List - 035-18466-000
- Economizer Accessory -
  Downflow Factory Installed
  Downflow Field Installed
  Horizontal Field Installed
- Motorized Outdoor Air Damper
- Manual Outdoor Air Damper (0-100%)
- Manual Outdoor Air Damper (0-35%)
- Gas Heat Propane Conversion Kit
- Gas Heat High Altitude Kit (Natural Gas)
- Gas Heat High Altitude Kit (Propane)
- –60°F Gas Heat Kit
- Electric Heater Accessory 50" cabinet
- Electric Heater Accessory 42" cabinet

Renewal Parts

Contact your local York® parts distribution center for authorized replacement parts.

Approvals

Design certified by CSA as follows:

1. For use as a cooling only unit, cooling unit with supplemental electric heat or a forced air furnace.
2. For outdoor installation only.
3. For installation on combustible material and may be installed directly on combustible flooring or, in the U.S., on wood flooring or Class A, Class B or Class C roof covering materials.
4. For use with natural gas (convertible to LP with kit).

⚠ CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state, and national codes including, but not limited to, building, electrical, and mechanical codes.

⚠ WARNING

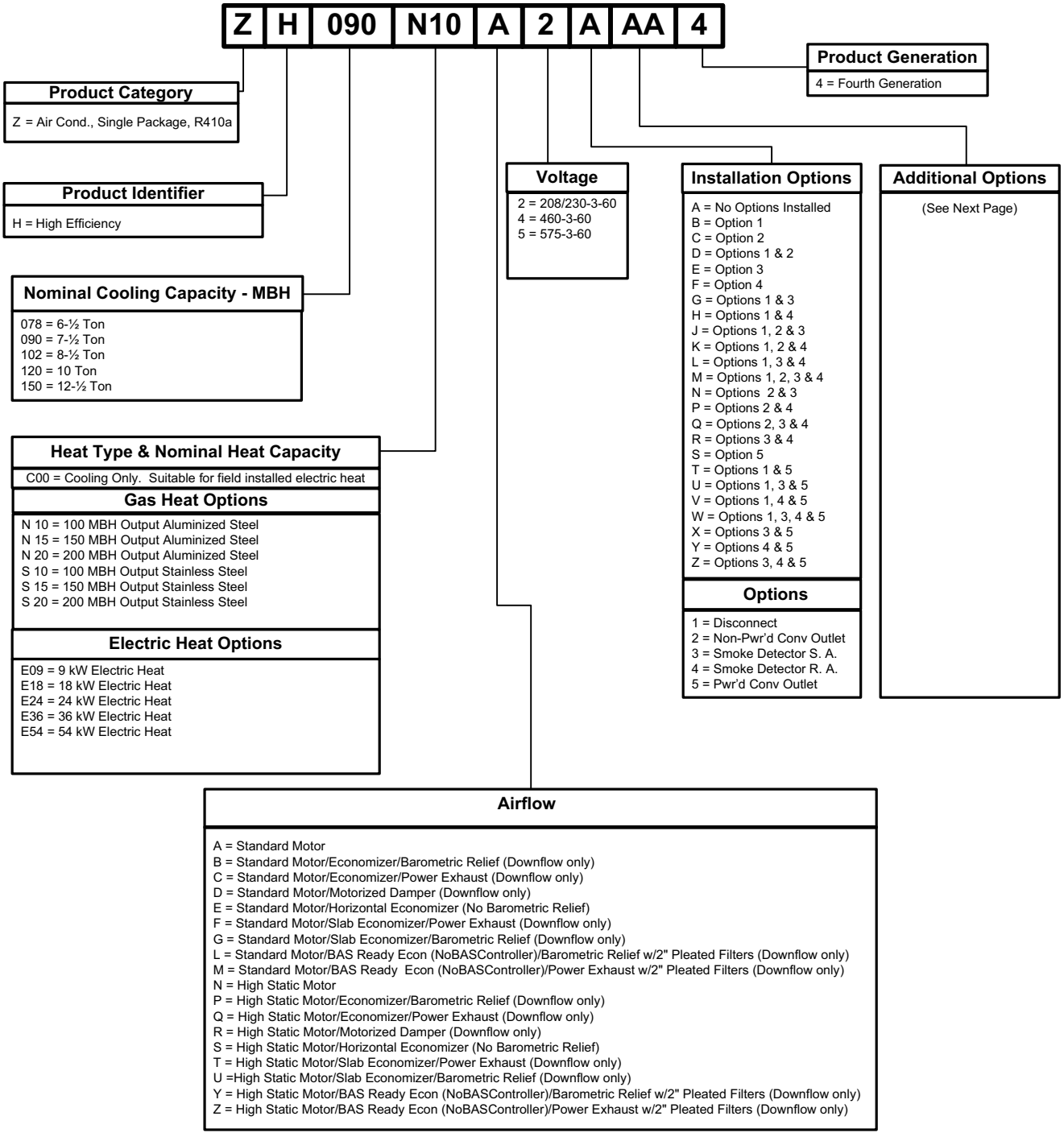
Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

Nomenclature

6½ - 12½ Ton Predator Model Number Nomenclature


Z H 090 N10 A 2 A AA 4
Product Generation
4 = Fourth Generation
Product Category
Z = Air Cond., Single Package, R410a
Product Identifier
H = High Efficiency
Nominal Cooling Capacity - MBH
078 = 6-½ Ton
090 = 7-½ Ton
102 = 8-½ Ton
120 = 10 Ton
150 = 12-½ Ton
Heat Type & Nominal Heat Capacity
C00 = Cooling Only. Suitable for field installed electric heat
Gas Heat Options
N 10 = 100 MBH Output Aluminized Steel
N 15 = 150 MBH Output Aluminized Steel
N 20 = 200 MBH Output Aluminized Steel
S 10 = 100 MBH Output Stainless Steel
S 15 = 150 MBH Output Stainless Steel
S 20 = 200 MBH Output Stainless Steel
Electric Heat Options
E09 = 9 kW Electric Heat
E18 = 18 kW Electric Heat
E24 = 24 kW Electric Heat
E36 = 36 kW Electric Heat
E54 = 54 kW Electric Heat
Voltage
2 = 208/230-3-60
4 = 460-3-60
5 = 575-3-60
Installation Options
A = No Options Installed
B = Option 1
C = Option 2
D = Options 1 & 2
E = Option 3
F = Option 4
G = Options 1 & 3
H = Options 1 & 4
J = Options 1, 2 & 3
K = Options 1, 2 & 4
L = Options 1, 3 & 4
M = Options 1, 2, 3 & 4
N = Options 2 & 3
P = Options 2 & 4
Q = Options 2, 3 & 4
R = Options 3 & 4
S = Option 5
T = Options 1 & 5
U = Options 1, 3 & 5
V = Options 1, 4 & 5
W = Options 1, 3, 4 & 5
X = Options 3 & 5
Y = Options 4 & 5
Z = Options 3, 4 & 5
Options
1 = Disconnect
2 = Non-Pwr'd Conv Outlet
3 = Smoke Detector S. A.
4 = Smoke Detector R. A.
5 = Pwr'd Conv Outlet
Additional Options
(See Next Page)
Airflow
A = Standard Motor
B = Standard Motor/Economizer/Barometric Relief (Downflow only)
C = Standard Motor/Economizer/Power Exhaust (Downflow only)
D = Standard Motor/Motorized Damper (Downflow only)
E = Standard Motor/Horizontal Economizer (No Barometric Relief)
F = Standard Motor/Slab Economizer/Power Exhaust (Downflow only)
G = Standard Motor/Slab Economizer/Barometric Relief (Downflow only)
L = Standard Motor/BAS Ready Econ (NoBASController)/Barometric Relief w/2" Pleated Filters (Downflow only)
M = Standard Motor/BAS Ready Econ (NoBASController)/Power Exhaust w/2" Pleated Filters (Downflow only)
N = High Static Motor
P = High Static Motor/Economizer/Barometric Relief (Downflow only)
Q = High Static Motor/Economizer/Power Exhaust (Downflow only)
R = High Static Motor/Motorized Damper (Downflow only)
S = High Static Motor/Horizontal Economizer (No Barometric Relief)
T = High Static Motor/Slab Economizer/Power Exhaust (Downflow only)
U =High Static Motor/Slab Economizer/Barometric Relief (Downflow only)
Y = High Static Motor/BAS Ready Econ (NoBASController)/Barometric Relief w/2" Pleated Filters (Downflow only)
Z = High Static Motor/BAS Ready Econ (NoBASController)/Power Exhaust w/2" Pleated Filters (Downflow only)

Nomenclature Additional Options

Additional Options	
AA	None
AB	Phase Monitor
AC	Coil Guard
AD	Dirty Filter Switch
AE	Phase Monitor & Coil Guard
AF	Phase Monitor & Dirty Filter Switch
AG	Coil Guard & Dirty Filter Switch
AH	Phase Monitor, Coil Guard, & Dirty Filter Switch
AJ	SS Drain Pan
AK	SS Drain Pan & Phase Monitor
AL	SS Drain Pan & Coil Guard
AM	SS Drain Pan & Dirty Filter Switch
AN	SS Drain Pan, Phase Monitor, Coil Guard & Dirty Filter Switch
CA	CPC Controller with Dirty Filter Switch & Air Proving Switch
CB	CPC Controller, DFS, APS & Phase Monitor
CC	CPC Controller, DFS, APS & Coil Guard
CD	CPC Controller, DFS, APS, Phase Monitor, & Coil Guard
CE	CPC Controller, DFS, APS & Technicoat Cond. Coil
CF	CPC Controller, DFS, APS, Technicoat Cond. Coil, & Phase Monitor
CG	CPC Controller, DFS, APS, Technicoat Cond. Coil, & Coil Guard
CH	CPC Controller, DFS, APS, Technicoat Cond. Coil, Phase Monitor, & Coil Guard
CJ	CPC Controller, DFS, APS & Technicoat Evap. Coil
CK	CPC Controller, DFS, APS, Technicoat Evap. Coil, & Phase Monitor
CL	CPC Controller, DFS, APS, Technicoat Evap. Coil, & Coil Guard
CM	CPC Controller, DFS, APS, Technicoat Evap. Coil, Phase Monitor, & Coil Guard
CN	CPC Controller, DFS, APS & Technicoat Evap. & Cond Coils
CP	CPC Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Phase Monitor
CQ	CPC Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Coil Guard
CR	CPC Controller, DFS, APS, Technicoat Evap. & Cond Coils, Phase Monitor, & Coil Guard
CS	CPC Controller, DFS, APS, SS Drain Pan
CT	CPC Controller, DFS, APS, SS Drain Pan, Phase Monitor, & Coil Guard
CU	CPC Controller, DFS, APS, SS Drain Pan, & Technicoat Cond Coils
CV	CPC Controller, DFS, APS, SS Drain Pan, & Technicoat Evap Coil
CW	CPC Controller, DFS, APS, SS Drain Pan, & Technicoat Evap and Cond Coils
CX	CPC Controller, DFS, APS, SS Drain Pan, Phase Monitor, Coil Guard, & Technicoat Evap and Cond Coils
JA	Johnson UNT Controller with Dirty Filter Switch & Air Proving Switch
JB	Johnson UNT Controller, DFS, APS & Phase Monitor
JC	Johnson UNT Controller, DFS, APS & Coil Guard
JD	Johnson UNT Controller, DFS, APS, Phase Monitor, & Coil Guard
JE	Johnson UNT Controller, DFS, APS & Technicoat Cond. Coil
JF	Johnson UNT Controller, DFS, APS, Technicoat Cond. Coil, & Phase Monitor
JG	Johnson UNT Controller, DFS, APS, Technicoat Cond. Coil, & Coil Guard
JH	Johnson UNT Controller, DFS, APS, Technicoat Cond. Coil, Phase Monitor, & Coil Guard
JJ	Johnson UNT Controller, DFS, APS & Technicoat Evap. Coil
JK	Johnson UNT Controller, DFS, APS, Technicoat Evap. Coil, & Phase Monitor
JL	Johnson UNT Controller, DFS, APS, Technicoat Evap. Coil, & Coil Guard
JM	Johnson UNT Controller, DFS, APS, Technicoat Evap. Coil, Phase Monitor, & Coil Guard
JN	Johnson UNT Controller, DFS, APS & Technicoat Evap. & Cond Coils
JP	Johnson UNT Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Phase Monitor
JQ	Johnson UNT Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Coil Guard
JR	Johnson UNT Controller, DFS, APS, Technicoat Evap. & Cond Coils, Phase Monitor, & Coil Guard
JS	Johnson UNT Controller, DFS, APS, SS Drain Pan
JT	Johnson UNT Controller, DFS, APS, SS Drain Pan, Phase Monitor, & Coil Guard
JU	Johnson UNT Controller, DFS, APS, SS Drain Pan, & Technicoat Cond Coils
JV	Johnson UNT Controller, DFS, APS, SS Drain Pan, & Technicoat Evap Coil
JW	Johnson UNT Controller, DFS, APS, SS Drain Pan, & Technicoat Evap and Cond Coils
JX	Johnson UNT Controller, DFS, APS, SS Drain Pan, Phase Monitor, Coil Guard, & Technicoat Evap and Cond Coils

Additional Options	
HA	Honeywell Excel 10 Controller with Dirty Filter Switch & Air Proving Switch
HB	Honeywell Excel 10 Controller, DFS, APS & Phase Monitor
HC	Honeywell Excel 10 Controller, DFS, APS & Coil Guard
HD	Honeywell Excel 10 Controller, DFS, APS, Phase Monitor, & Coil Guard
HE	Honeywell Excel 10 Controller, DFS, APS & Technicoat Cond. Coil
HF	Honeywell Excel 10 Controller, DFS, APS, Technicoat Cond. Coil, & Phase Monitor
HG	Honeywell Excel 10 Controller, DFS, APS, Technicoat Cond. Coil, & Coil Guard
HH	Honeywell Excel 10 Controller, DFS, APS, Technicoat Cond. Coil, Phase Monitor, & Coil Guard
HJ	Honeywell Excel 10 Controller, DFS, APS & Technicoat Evap. Coil
HK	Honeywell Excel 10 Controller, DFS, APS, Technicoat Evap. Coil, & Phase Monitor
HL	Honeywell Excel 10 Controller, DFS, APS, Technicoat Evap. Coil, & Coil Guard
HM	Honeywell Excel 10 Controller, DFS, APS, Technicoat Evap. Coil, Phase Monitor, & Coil Guard
HN	Honeywell Excel 10 Controller, DFS, APS & Technicoat Evap. & Cond Coils
HP	Honeywell Excel 10 Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Phase Monitor
HQ	Honeywell Excel 10 Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Coil Guard
HR	Honeywell Excel 10 Controller, DFS, APS, Technicoat Evap. & Cond Coils, Phase Monitor, & Coil Guard
HS	Honeywell Excel 10 Controller, DFS, APS, SS Drain Pan
HT	Honeywell Excel 10 Controller, DFS, APS, SS Drain Pan, Phase Monitor, & Coil Guard
HU	Honeywell Excel 10 Controller, DFS, APS, SS Drain Pan, & Technicoat Cond Coils
HV	Honeywell Excel 10 Controller, DFS, APS, SS Drain Pan, & Technicoat Evap Coil
HW	Honeywell Excel 10 Controller, DFS, APS, SS Drain Pan, & Technicoat Evap and Cond Coils
HX	Honeywell Excel 10 Controller, DFS, APS, SS Drain Pan, Phase Monitor, Coil Guard, & Technicoat Evap and Cond Coils
WA	Intelli-Comfort w/ModLINC Controller
WB	Intelli-Comfort w/ModLINC Controller, & Phase Monitor
WC	Intelli-Comfort w/ModLINC Controller, & Coil Guard
WD	Intelli-Comfort w/ModLINC Controller, Phase Monitor, & Coil Guard
WE	Intelli-Comfort w/ModLINC Controller, & Technicoat Cond. Coil
WF	Intelli-Comfort w/ModLINC Controller, Technicoat Cond. Coil, & Phase Monitor
WG	Intelli-Comfort w/ModLINC Controller, Technicoat Cond. Coil, & Coil Guard
WH	Intelli-Comfort w/ModLINC Controller, Technicoat Cond. Coil, Phase Monitor, & Coil Guard
WJ	Intelli-Comfort w/ModLINC Controller, & Technicoat Evap. Coil
WK	Intelli-Comfort w/ModLINC Controller, Technicoat Evap. Coil, & Phase Monitor
WL	Intelli-Comfort w/ModLINC Controller, Technicoat Evap. Coil, & Coil Guard
WM	Intelli-Comfort w/ModLINC Controller, Technicoat Evap. Coil, Phase Monitor, & Coil Guard
WN	Intelli-Comfort w/ModLINC Controller, & Technicoat Evap. & Cond Coils
WP	Intelli-Comfort w/ModLINC Controller, Technicoat Evap. & Cond Coils, & Phase Monitor
WQ	Intelli-Comfort w/ModLINC Controller, Technicoat Evap. & Cond Coils, & Coil Guard
WR	Intelli-Comfort w/ModLINC Controller, Technicoat Evap. & Cond Coils, Phase Monitor, & Coil Guard
WS	Intelli-Comfort w/ModLINC Controller, SS Drain Pan
WT	Intelli-Comfort w/ModLINC Controller, SS Drain Pan, Phase Monitor, & Coil Guard
WU	Intelli-Comfort w/ModLINC Controller, SS Drain Pan, & Technicoat Cond Coils
WV	Intelli-Comfort w/ModLINC Controller, SS Drain Pan, & Technicoat Evap Coil
WW	Intelli-Comfort w/ModLINC Controller, SS Drain Pan, & Technicoat Evap and Cond Coils
WX	Intelli-Comfort w/ModLINC Controller, SS Drain Pan, Phase Monitor, Coil Guard, & Technicoat Evap and Cond Coils
NA	Novar ETC-3 Controller with Dirty Filter Switch & Air Proving Switch
NB	Novar ETC-3 Controller, DFS, APS & Phase Monitor
NC	Novar ETC-3 Controller, DFS, APS & Coil Guard
ND	Novar ETC-3 Controller, DFS, APS, Phase Monitor, & Coil Guard
NE	Novar ETC-3 Controller, DFS, APS & Technicoat Cond. Coil
NF	Novar ETC-3 Controller, DFS, APS, Technicoat Cond. Coil, & Phase Monitor
NG	Novar ETC-3 Controller, DFS, APS, Technicoat Cond. Coil, & Coil Guard
NH	Novar ETC-3 Controller, DFS, APS, Technicoat Cond. Coil, Phase Monitor, & Coil Guard
NJ	Novar ETC-3 Controller, DFS, APS & Technicoat Evap. Coil
NK	Novar ETC-3 Controller, DFS, APS, Technicoat Evap. Coil, & Phase Monitor
NL	Novar ETC-3 Controller, DFS, APS, Technicoat Evap. Coil, & Coil Guard
NM	Novar ETC-3 Controller, DFS, APS, Technicoat Evap. Coil, Phase Monitor, & Coil Guard
NN	Novar ETC-3 Controller, DFS, APS & Technicoat Evap. & Cond Coils
NP	Novar ETC-3 Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Phase Monitor
NQ	Novar ETC-3 Controller, DFS, APS, Technicoat Evap. & Cond Coils, & Coil Guard

Additional Options	
NR	Novar ETC-3 Controller, DFS, APS, Technicoat Evap. & Cond Coils, Phase Monitor, & Coil Guard
NS	Novar ETC-3 Controller, DFS, APS, SS Drain Pan
NT	Novar ETC-3 Controller, DFS, APS, SS Drain Pan, Phase Monitor, & Coil Guard
NU	Novar ETC-3 Controller, DFS, APS, SS Drain Pan, & Technicoat Cond Coils
NV	Novar ETC-3 Controller, DFS, APS, SS Drain Pan, & Technicoat Evap Coil
NW	Novar ETC-3, DFS, APS, SS Drain Pan, & Technicoat Evap and Cond Coils
NX	Novar ETC-3 Controller, DFS, APS, SS Drain Pan, Phase Monitor, Coil Guard, & Technicoat Evap and Cond Coils
LA	Simplicity Intelli-Comfort Controller
LB	Simplicity Intelli-Comfort Controller, & Phase Monitor
LC	Simplicity Intelli-Comfort Controller, & Coil Guard
LD	Simplicity Intelli-Comfort Controller, Phase Monitor, & Coil Guard
LE	Simplicity Intelli-Comfort Controller, & Technicoat Cond. Coil
LF	Simplicity Intelli-Comfort Controller, Technicoat Cond. Coil, & Phase Monitor
LG	Simplicity Intelli-Comfort Controller, Technicoat Cond. Coil, & Coil Guard
LH	Simplicity Intelli-Comfort Controller, Technicoat Cond. Coil, Phase Monitor, & Coil Guard
LJ	Simplicity Intelli-Comfort Controller, & Technicoat Evap. Coil
LK	Simplicity Intelli-Comfort Controller, Technicoat Evap. Coil, & Phase Monitor
LL	Simplicity Intelli-Comfort Controller, Technicoat Evap. Coil, & Coil Guard
LM	Simplicity Intelli-Comfort Controller, Technicoat Evap. Coil, Phase Monitor, & Coil Guard
LN	Simplicity Intelli-Comfort Controller, & Technicoat Evap. & Cond Coils
LP	Simplicity Intelli-Comfort Controller, Technicoat Evap. & Cond Coils, & Phase Monitor
LQ	Simplicity Intelli-Comfort Controller, Technicoat Evap. & Cond Coils, & Coil Guard
LR	Simplicity Intelli-Comfort Controller, Technicoat Evap. & Cond Coils, Phase Monitor, & Coil Guard
LS	Simplicity Intelli-Comfort Controller, SS Drain Pan
LT	Simplicity Intelli-Comfort Controller, SS Drain Pan, Phase Monitor, & Coil Guard
LU	Simplicity Intelli-Comfort Controller, SS Drain Pan, & Technicoat Cond Coils
LV	Simplicity Intelli-Comfort Controller, SS Drain Pan, & Technicoat Evap Coil
LW	Simplicity Intelli-Comfort Controller, SS Drain Pan, & Technicoat Evap and Cond Coils
LX	Simplicity Intelli-Comfort Controller, SS Drain Pan, Phase Monitor, Coil Guard, & Technicoat Evap and Cond Coils
TA	Technicoat Condenser Coil
TB	Technicoat Condenser Coil & Phase Monitor
TC	Technicoat Condenser Coil & Coil Guard
TD	Technicoat Condenser Coil & Dirty Filter Switch
TE	Technicoat Condenser Coil, Phase Monitor, & Coil Guard
TF	Technicoat Condenser Coil, Phase Monitor, & Dirty Filter Switch
TG	Technicoat Condenser Coil, Coil Guard, & Dirty Filter Switch
TH	Technicoat Condenser Coil, Phase Monitor, Coil Guard, & Dirty Filter Switch
TJ	Technicoat Evaporator Coil
TK	Technicoat Evaporator Coil & Phase Monitor
TL	Technicoat Evaporator Coil & Coil Guard
TM	Technicoat Evaporator Coil & Dirty Filter Switch
TN	Technicoat Evaporator Coil, Phase Monitor, & Coil Guard
TP	Technicoat Evaporator Coil, Phase Monitor, & Dirty Filter Switch
TQ	Technicoat Evaporator Coil, Coil Guard, & Dirty Filter Switch
TR	Technicoat Evaporator Coil, Phase Monitor, Coil Guard, & Dirty Filter Switch
TS	Technicoat Evaporator & Condenser Coils
TT	Technicoat Evaporator & Condenser Coils & Phase Monitor
TU	Technicoat Evaporator & Condenser Coils & Coil Guard
TV	Technicoat Evaporator & Condenser Coils & Dirty Filter Switch
TW	Technicoat Evaporator & Condenser Coils, Phase Monitor, & Coil Guard
TX	Technicoat Evaporator & Condenser Coils, Phase Monitor, & Dirty Filter Switch
TY	Technicoat Evaporator & Condenser Coils, Coil Guard, & Dirty Filter Switch
TZ	Technicoat Evaporator & Condenser Coils, Phase Monitor, Coil Guard, & Dirty Filter Switch
T1	Technicoat Condenser & SS Drain Pan
T3	Technicoat Condenser Coil, SS Drain Pan, Phase Monitor, Coil Guard, & Dirty Filter Switch
T4	Technicoat Evaporator & SS Drain Pan
T6	Technicoat Evaporator Coil, SS Drain Pan, Phase Monitor, Coil Guard, & Dirty Filter Switch
T7	Technicoat Evaporator & Condenser Coils & SS Drain Pan
T9	Technicoat Evaporator & Condenser Coils, SS Drain Pan, Phase Monitor, Coil Guard, & Dirty Filter Switch

Installation

Installation Safety Information

Read these instructions before continuing this appliance installation. This is an outdoor combination heating and cooling unit. The installer must assure that these instructions are made available to the consumer and with instructions to retain them for future reference.

1. Refer to the unit rating plate for the approved type of gas for this product.
2. Install this unit only in a location and position as specified on Page 10 of these instructions.
3. Never test for gas leaks with an open flame. Use commercially available soap solution made specifically for the detection of leaks when checking all connections, as specified on Pages 8, 32, 33 and 57 of these instructions.
4. Always install furnace to operate within the furnace's intended temperature-rise range with the duct system and within the allowable external static pressure range, as specified on the unit name/rating plate, specified on Page 59 of these instructions.
5. This equipment is not to be used for temporary heating of buildings or structures under construction.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Preceding Installation

1. Remove the two screws holding the brackets in the front, rear and compressor side fork-lift slots.

Figure 1: Unit Shipping Bracket

2. Turn each bracket toward the ground and the protective plywood covering will drop to the ground.
3. Remove the condenser coil external protective covering prior to operation.
4. Remove the toolless doorknobs and instruction packet prior to installation.

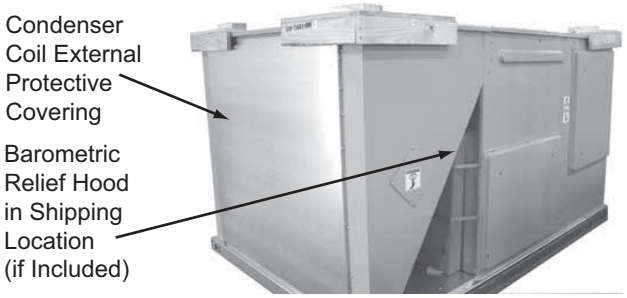


Figure 2: Condenser Covering

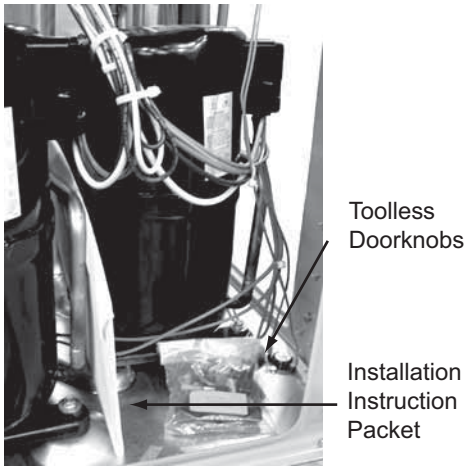


Figure 3: Compressor Section

Limitations

These units must be installed in accordance with the following:

In U.S.A.:

1. National Electrical Code, ANSI/NFPA No. 70 - Latest Edition
2. National Fuel Gas Code, ANSI Z223.1 - Latest Edition
3. Gas-Fired Central Furnace Standard, ANSI Z21.47a. - Latest Edition
4. Local building codes, and
5. Local gas utility requirements

In Canada:

1. Canadian Electrical Code, CSA C22.1
2. Installation Codes, CSA - B149.1.
3. Local plumbing and waste water codes, and
4. Other applicable local codes.

Refer to unit application data found in this document.

After installation, gas fired units must be adjusted to obtain a temperature rise within the range specified on the unit rating plate.

If components are to be added to a unit to meet local codes, they are to be installed at the dealer's and/or customer's expense.

Size of unit for proposed installation should be based on heat loss/heat gain calculation made according to the methods of Air Conditioning Contractors of America (ACCA).

This furnace is not to be used for temporary heating of buildings or structures under construction.

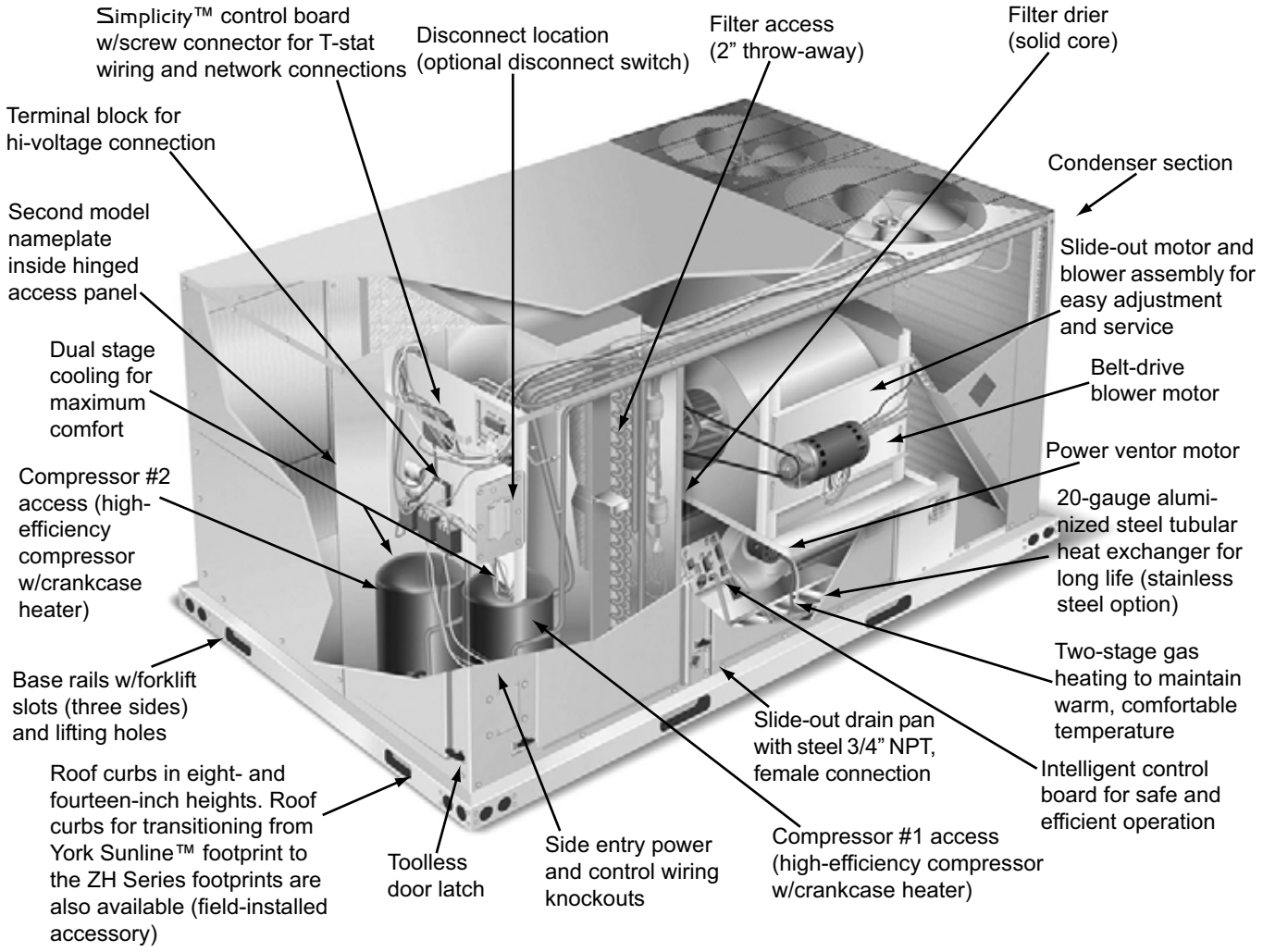

Simplicity™ control board w/screw connector for T-stat wiring and network connections
Disconnect location (optional disconnect switch)
Filter access (2" throw-away)
Filter drier (solid core)
Terminal block for hi-voltage connection
Condenser section
Second model nameplate inside hinged access panel
Slide-out motor and blower assembly for easy adjustment and service
Dual stage cooling for maximum comfort
Belt-drive blower motor
Power ventor motor
Compressor #2 access (high-efficiency compressor w/crankcase heater)
20-gauge alumi-nized steel tubular heat exchanger for long life (stainless steel option)
Two-stage gas heating to maintain warm, comfortable temperature
Base rails w/forklift slots (three sides) and lifting holes
Slide-out drain pan with steel 3/4" NPT, female connection
Intelligent control board for safe and efficient operation
Roof curbs in eight- and fourteen-inch heights. Roof curbs for transitioning from York Sunline™ footprint to the ZH Series footprints are also available (field-installed accessory)
Toolless door latch
Side entry power and control wiring knockouts
Compressor #1 access (high-efficiency compressor w/crankcase heater)

Figure 4: Predator® Component Location (ZH120 Shown)

Table 1: ZH078-150 Unit Limitations

Size (Tons)	Model	Unit Voltage	Unit Limitations		
			Applied Voltage		Outdoor DB Temp
			Min	Max	Max (°F)
078 (6.5)	ZH	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
090 (7.5)	ZH	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
102 (8.5)	ZH	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
120 (10)	ZH	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125
150 (12.5)	ZH	208/230-3-60	187	252	125
		460-3-60	432	504	125
		575-3-60	540	630	125

Location

Use the following guidelines to select a suitable location for these units:

1. Unit is designed for *outdoor installation only*.
2. Condenser coils must have an unlimited supply of air. Where a choice of location is possible, position the unit on either north or east side of building.
3. Suitable for mounting on roof curb.
4. For ground level installation, use a level concrete slab with a minimum thickness of 4 inches. The length and width should be at least 6 inches greater than the unit base rails. Do not tie slab to the building foundation.
5. Roof structures must be able to support the weight of the unit and its options/accessories. Unit must be installed on a solid, level roof curb or appropriate angle iron frame.
6. Maintain level tolerance to 1/2” across the entire width and length of unit.

⚠WARNING

Excessive exposure of this furnace to contaminated combustion air may result in equipment damage or personal injury. Typical contaminates include: permanent wave solution, chlorinated waxes and cleaners, chlorine based swimming pool chemicals, water softening chemicals, carbon tetrachloride, Halogen type refrigerants, cleaning solvents (e.g. perchloroethylene), printing inks, paint removers, varnishes, hydrochloric acid, cements and glues, antistatic fabric softeners for clothes dryers, masonry acid washing materials.

Clearances

All units require particular clearances for proper operation and service. Installer must make provisions for adequate combustion and ventilation air in accordance with section 5.3 of Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 – Latest Edition (in U.S.A.), or Sections 7.2, 7.3, or 7.4 of Gas Installation Codes, CSA-B149.1 (in Canada) - Latest Edition, and/or applicable provisions of the local building codes. Refer to Table 5 for clearances required for combustible construction, servicing, and proper unit operation.

⚠WARNING

Do not permit overhanging structures or shrubs to obstruct condenser air discharge outlet, combustion air inlet or vent outlets.

Rigging And Handling

Exercise care when moving the unit. Do not remove any packaging until the unit is near the place of installation. Rig the unit by attaching chain or cable slings to the lifting holes provided in the base rails. Spreader bars, whose length exceeds the largest dimension across the unit, **MUST** be used across the top of the unit.

⚠ CAUTION

If a unit is to be installed on a roof curb other than a York® roof curb, gasketing must be applied to all surfaces that come in contact with the unit underside.

⚠ CAUTION

Before lifting, make sure the unit weight is distributed equally on the rigging cables so it will lift evenly.

Units may be moved or lifted with a forklift. Slotted openings in the base rails are provided for this purpose.

LENGTH OF FORKS MUST BE A MINIMUM OF 60 INCHES.

⚠ CAUTION

All panels must be secured in place when the unit is lifted.

The condenser coils should be protected from rigging cable damage with plywood or other suitable material.

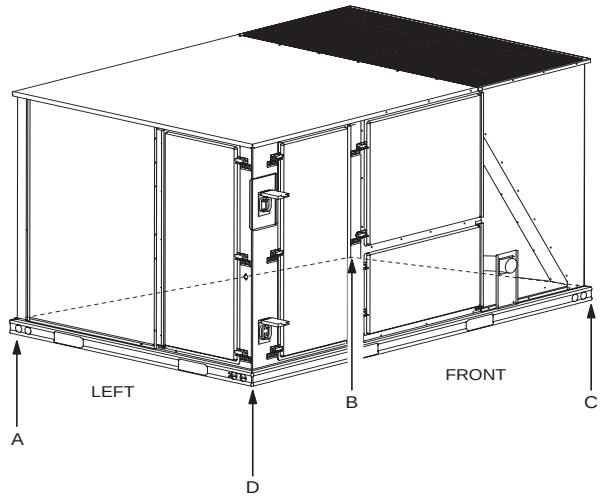


Figure 5: Unit 4 Point Load Weight

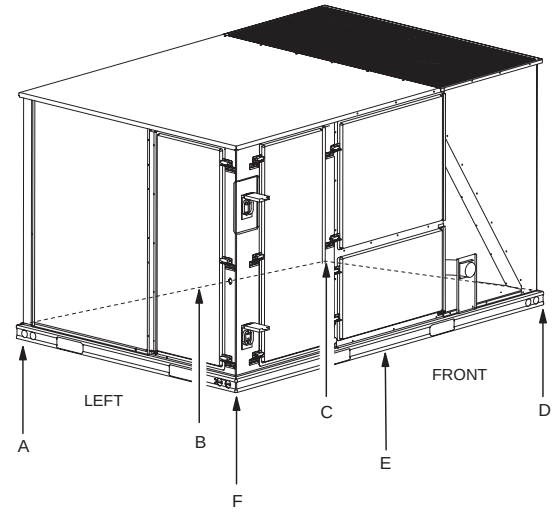


Figure 6: Unit 6 Point Load Weight

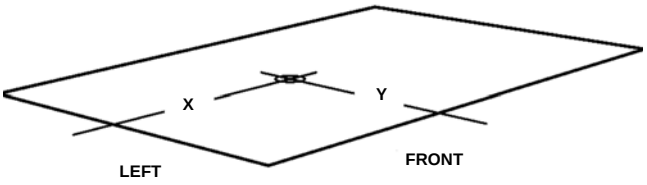


Figure 7: Center of Gravity

Table 2: Weights and Dimensions

Size (Tons)	Model	Weight (lbs.)		Center of Gravity		4 Point Load Location (lbs.)				6 Point Load Location (lbs.)					
		Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
078 (6.5)	ZH	905	900	38	23	201	150	234	315	141	115	95	149	180	221
090 (7.5)	ZH	925	920	38	23	206	153	240	322	144	117	97	152	184	225
102 (8.5)	ZH	1140	1135	38	25.5	281	209	275	369	197	160	133	175	211	259
120 (10)	ZH	1140	1135	38	25.5	281	209	275	369	197	160	133	175	211	259
150 (12.5)	ZH	1405	1400	51	25.5	258	347	456	339	164	198	243	319	260	216

Table 3: ZH078-150 Unit Accessory Weights

Unit Accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	90	85
Power Exhaust	155	150
Electric Heat[1]	80	80
Gas Heat[2]	110	110

1. Weight given is for the maximum heater size available (54KW).
2. Weight given is for the maximum number of tube heat exchangers available (8 tube).

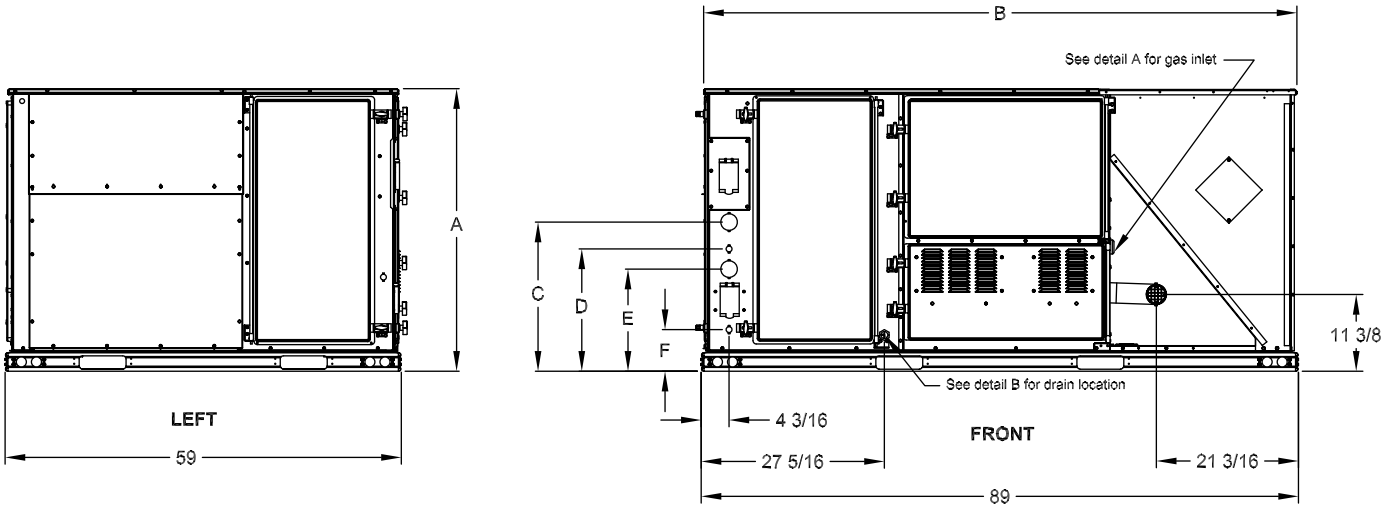


Figure 8: ZH078-120 Physical Dimensions

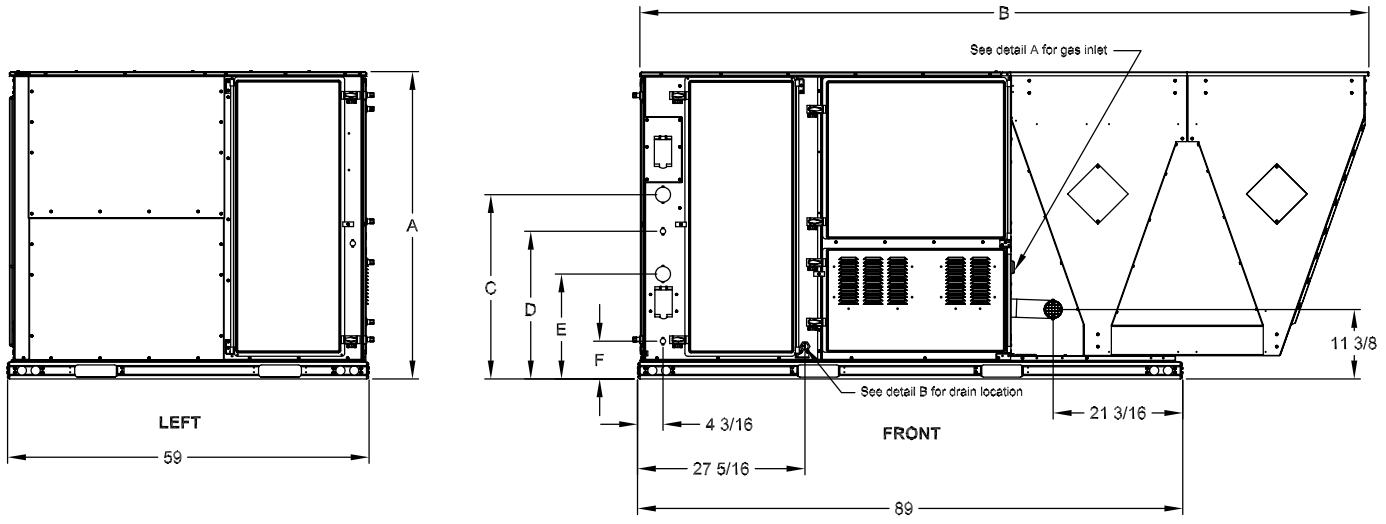
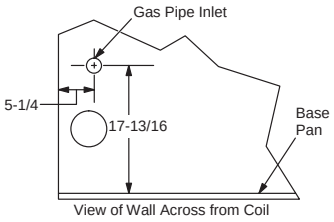


Figure 9: ZH150 Physical Dimensions

Table 4: ZH078-150 Unit Physical Dimensions

Unit Model Number	Dimension (in.)					
	A	B	C	D	E	F
ZH078	42	89	22 1/8	18 3/16	15 3/16	6 3/16
ZH090	42	89	22 1/8	18 3/16	15 3/16	6 3/16
ZH102	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
ZH120	50 3/4	89	30 3/16	24 3/16	17 3/16	6 3/16
ZH150	50 3/4	119 1/2	30 3/16	24 3/16	17 3/16	6 3/16

Detail A



Detail B

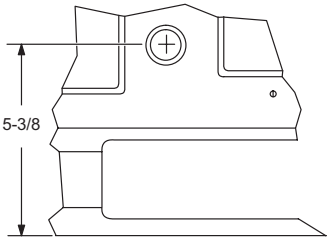


Table 5: ZH078-150 Unit Clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top[1]	72	Right	12
Front	36	Left	36
Rear	36	Bottom[2]	0

1. Units must be installed outdoors. Over hanging structure or shrubs should not obscure condenser air discharge outlet.
2. Units may be installed on combustable floors made from wood or class A, B or C roof covering materials.

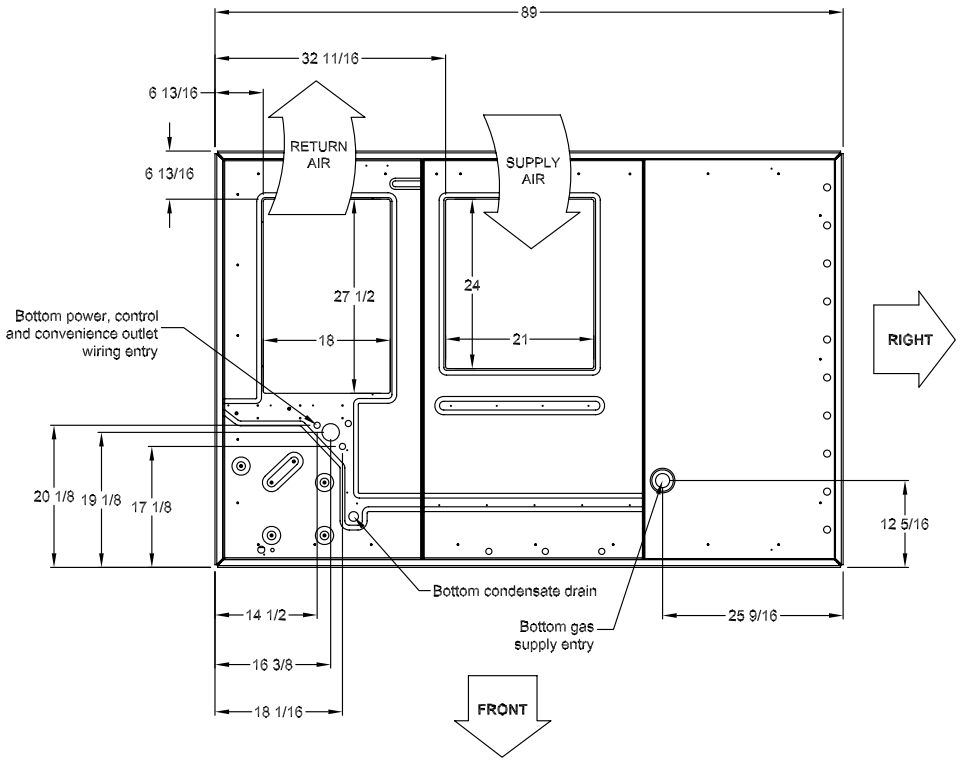


Figure 10: ZH078-150 Unit Bottom Duct Openings

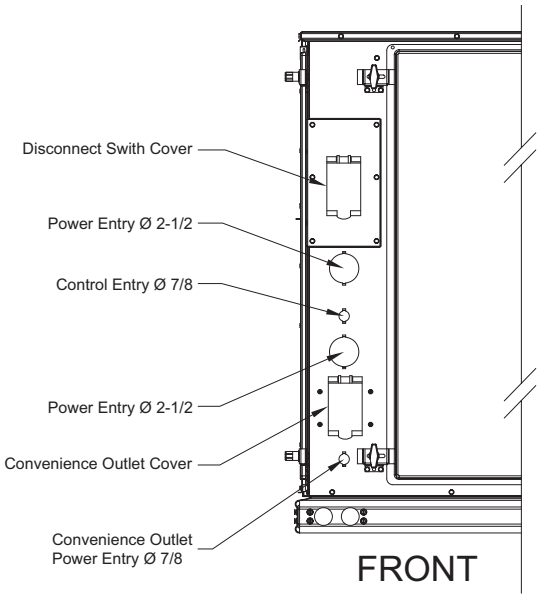


Figure 11: ZH078-150 Unit Electrical Entry

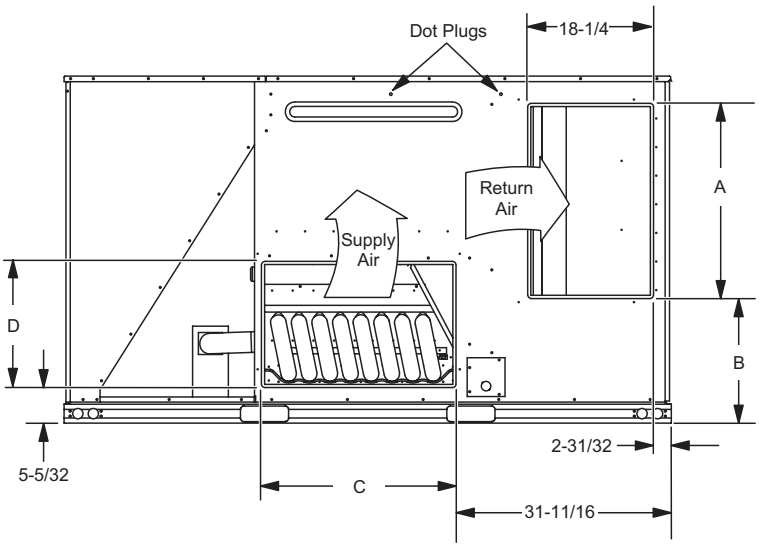


Figure 12: ZH078-120 Unit Side Duct Openings

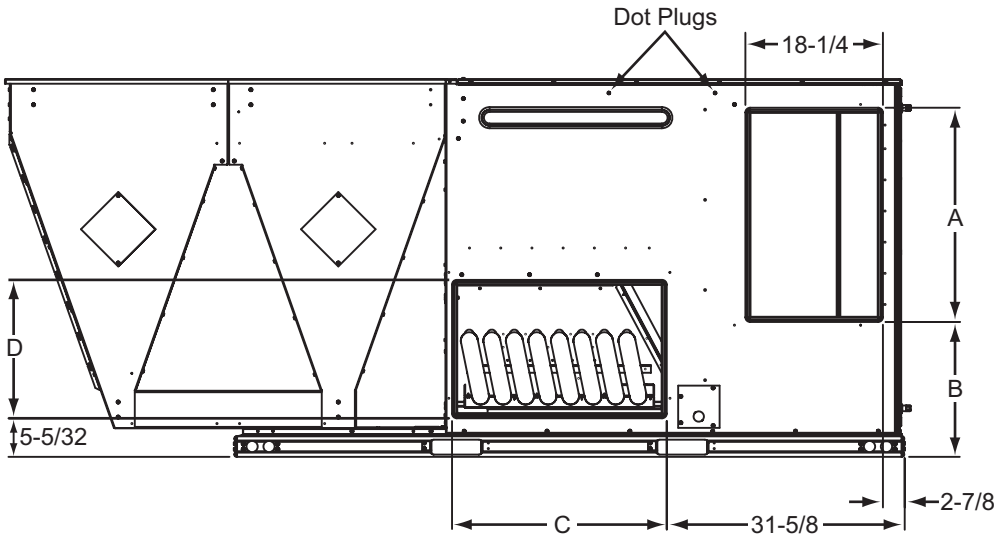


Figure 13: ZH150 Unit Side Duct Openings

Table 6: Side Duct Dimensions

Unit Model Number	Dimension (in.)			
	A	B	C	D
ZH078	27 3/4	12 1/16	27 1/2	16
ZH090	27 3/4	12 1/16	27 1/2	16
ZH102	28 1/4	18 1/16	28 1/4	18 1/4
ZH120	28 1/4	18 1/16	28 1/4	18 1/4
ZH150	28 1/4	18 1/16	28 1/4	18 1/4

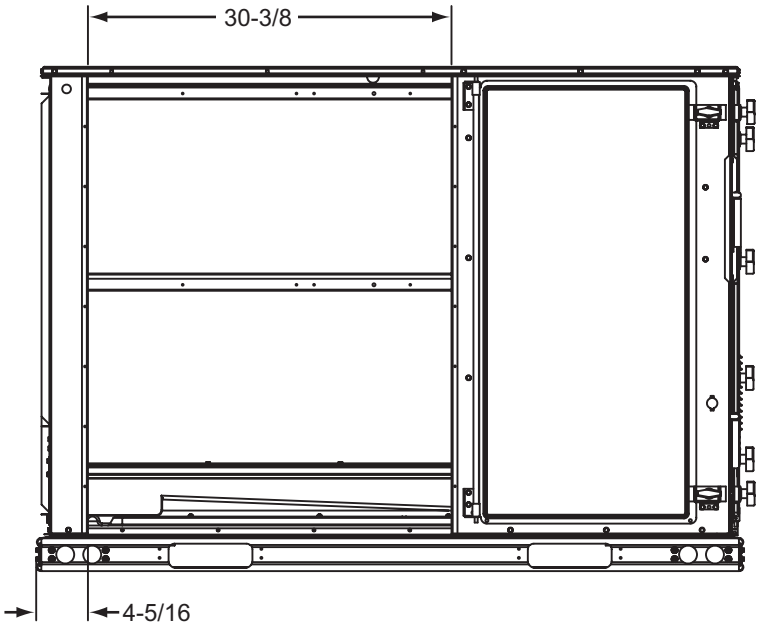


Figure 14: ZH078-150 Unit Left Duct Opening

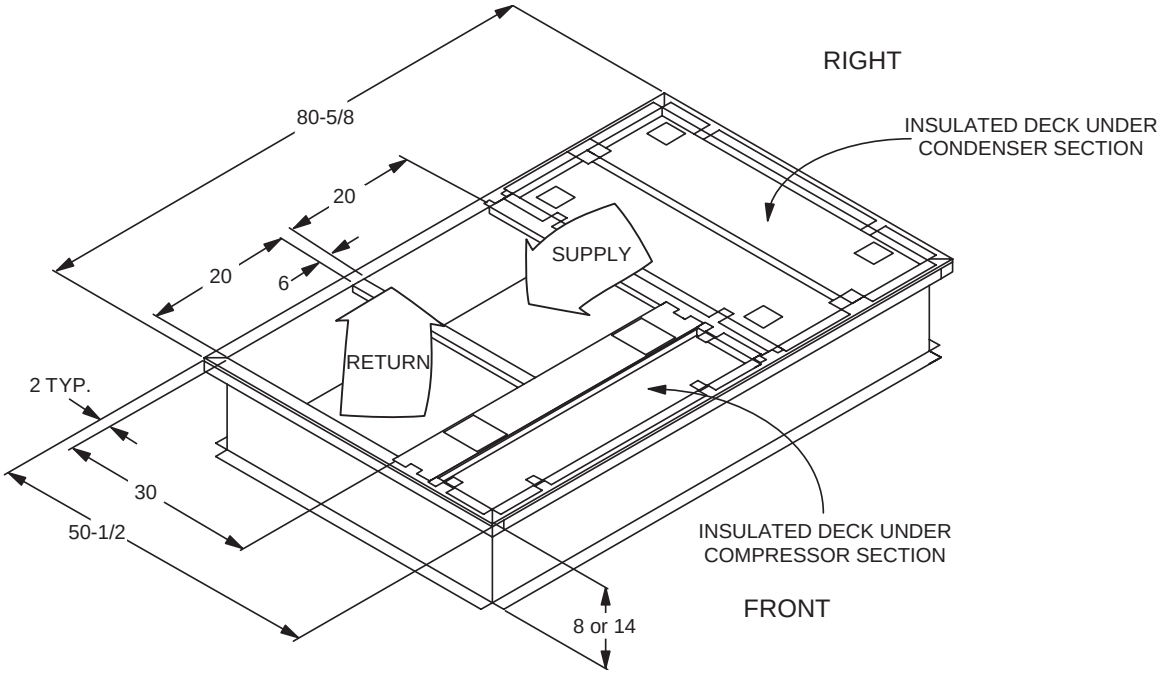


Figure 15: ZH078-150 Roof Curb

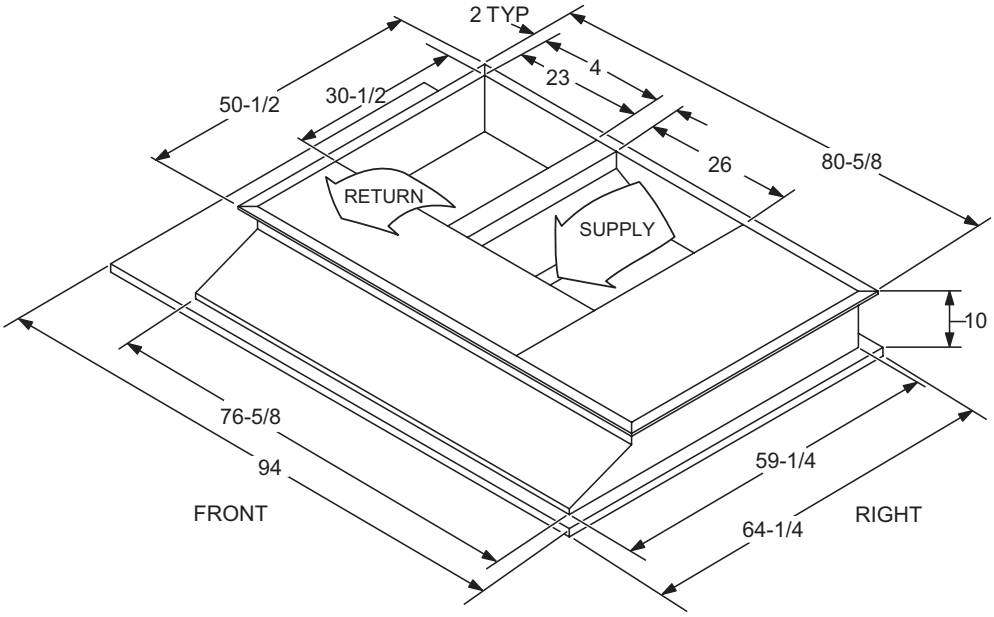


Figure 16: ZH078-150 Transition Roof Curb

Ductwork

Ductwork should be designed and sized according to the methods in Manual D of the Air Conditioning Contractors of America (ACCA) or as recommended by any other recognized authority such as ASHRAE or SMACNA.

A closed return duct system should be used. This will not preclude use of economizers or outdoor fresh air intake. The supply and return air duct connections at the unit should be made with flexible joints to minimize noise.

The supply and return air duct systems should be designed for the CFM and static pressure requirements of the job. They should NOT be sized to match the dimensions of the duct connections on the unit.

Refer to Figure 10 for bottom air duct openings. Refer to Figures 12, 13 and Table 6 for side air duct openings.

Duct Covers

Units are shipped with the side duct openings covered and a covering over the bottom of the unit. For bottom duct application, no duct cover changes are necessary. For side duct application, remove the side duct covers and install over the bottom duct openings. The panels removed from the side duct connections are designed to be reused by securing each panel to its respective downflow opening. But keep in mind that the supply panel is installed with the painted surface UP, facing the heat exchanger, while the return panel is installed with the painted surface DOWN, facing the downflow duct opening. The supply panel is secured with the bracket (already in place from the factory) and two screws. It's a snug fit for the panel when sliding it between the heat exchanger and unit bottom, but there is room. The return panel is secured with four screws.

⚠ CAUTION

When fastening ductwork to side duct flanges on unit, insert screws through duct flanges only. DO NOT insert screws through casing. Outdoor ductwork must be insulated and water-proofed.

Figure 17: Side Panels With Hole Plugs

NOTE: Orientation. Panel is "insulation" side up.

Figure 18: Return Downflow Plenum With Panel

Figure 19: Discharge Panel In Place

Condensate Drain

The side condensate drain is reversible and maybe re-oriented to the rear of the cabinet to facilitate condensate piping. A condensate drain connection is available through the base pan for piping inside the roof curb. Trap the connection per Figure 20. The trap and drain lines should be protected from freezing.

Plumbing must conform to local codes. Use a sealing compound on male pipe threads. Install condensate drain line from the 3/4 inch NPT female connection on the unit to an open drain.

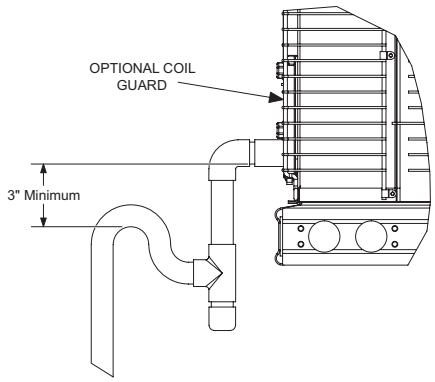


Figure 20: Condensate Drain

Compressors

The scroll compressor used in this product is specifically designed to operate with R-410A Refrigerant and cannot be interchanged.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

The compressor also uses a polyolester (POE oil), Mobil 3MA POE. This oil is extremely hygroscopic, meaning it absorbs water readily. POE oil can absorb 15 times as much water as other oils

designed for HCFC and CFC refrigerants. Take all necessary precautions to avoid exposure of the oil to the atmosphere.

⚠ CAUTION

Do not leave the system open to the atmosphere. Unit damage could occur due to moisture being absorbed by the **POE oil** in the system. This type of oil is highly susceptible to moisture absorption

POE (polyolester) compressor lubricants are known to cause long term damage to some synthetic roofing materials.

⚠ CAUTION

Exposure, even if immediately cleaned up, may cause embrittlement (leading to cracking) to occur in one year or more. When performing any service that may risk exposure of compressor oil to the roof, take precautions to protect roofing.

Procedures which risk oil leakage include, but are not limited to, compressor replacement, repairing refrigerant leaks, replacing refrigerant components such as filter drier, pressure switch, metering device or coil.

Units are shipped with compressor mountings which are factory-adjusted and ready for operation.

⚠ CAUTION

Do not loosen compressor mounting bolts.

Filters

Two-inch filters are supplied with each unit. One-inch filters may be used with no modification to the filter racks. Filters must always be installed ahead of evaporator coil and must be kept clean or replaced with same size and type. Dirty filters reduce the capacity of the unit and result in frosted coils or safety shutdown. Refer to physical data tables, for the number and size of filters needed for the unit. The unit should not be operated without filters properly installed.

⚠ CAUTION

Make sure that panel latches are properly positioned on the unit to maintain an airtight seal.

Power And Control Wiring

Field wiring to the unit, fuses, and disconnects must conform to provisions of National Electrical Code (NEC), ANSI/NFPA No. 70 – Latest Edition (in U.S.A.), current Canadian Electrical Code C221, and/or local ordinances. The unit must be electrically grounded in accordance with NEC and CEC as specified above and/or local codes.

Voltage tolerances which must be maintained at the compressor terminals during starting and running conditions are indicated on the unit Rating Plate and Table 1.

The internal wiring harnesses furnished with this unit are an integral part of the design certified unit. Field alteration to comply with electrical codes should not be required. If any of the wire supplied with the unit must be replaced, replacement wire must be of the type shown on the wiring diagram and the same minimum gauge as the replaced wire.

A disconnect must be utilized for these units. Factory installed disconnects are available. If installing a disconnect (field supplied or York International® supplied accessory), refer to Figure 4 for the recommended mounting location.

⚠ CAUTION

Avoid damage to internal components if drilling holes for disconnect mounting.

NOTE: Since not all local codes allow the mounting of a disconnect on the unit, please confirm compliance with local code before mounting a disconnect on the unit.

Electrical line must be sized properly to carry the load. USE COPPER CONDUCTORS ONLY. Each unit must be wired with a separate branch circuit fed directly from the meter panel and properly fused.

Refer to Figures 21, 22, 23 and 24 for typical field wiring and to the appropriate unit wiring diagram mounted inside control doors for control circuit and power wiring information.

⚠ CAUTION

When connecting electrical power and control wiring to the unit, water-proof connectors must be used so that water or moisture cannot be drawn into the unit during normal operation. The above water-proofing conditions will also apply when installing a field supplied disconnect switch.

Power Wiring Detail

Units are factory wired for the voltage shown on the unit nameplate. Refer to Electrical Data Table 8 to size power wiring, fuses, and disconnect switch.

Power wiring is brought into the unit through the side of the unit or the basepan inside the curb.

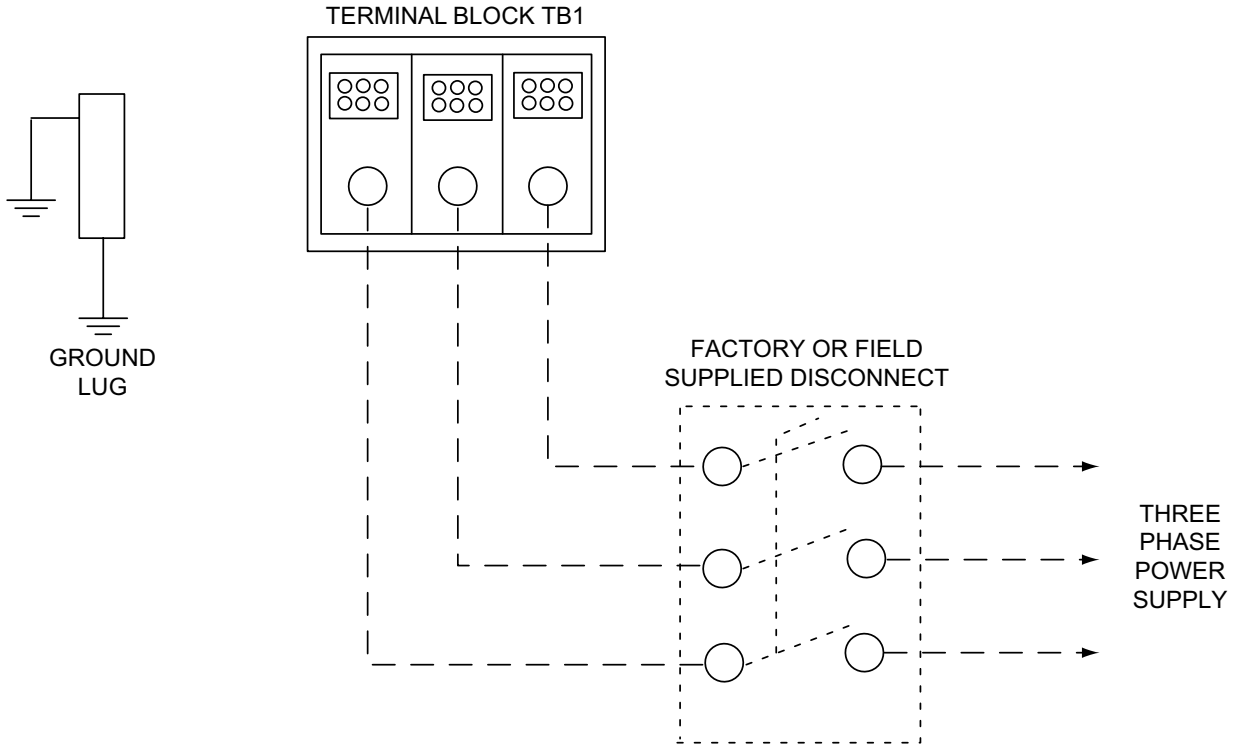


Figure 21: Field Wiring Disconnect - Cooling Unit With/Without Electric Heat

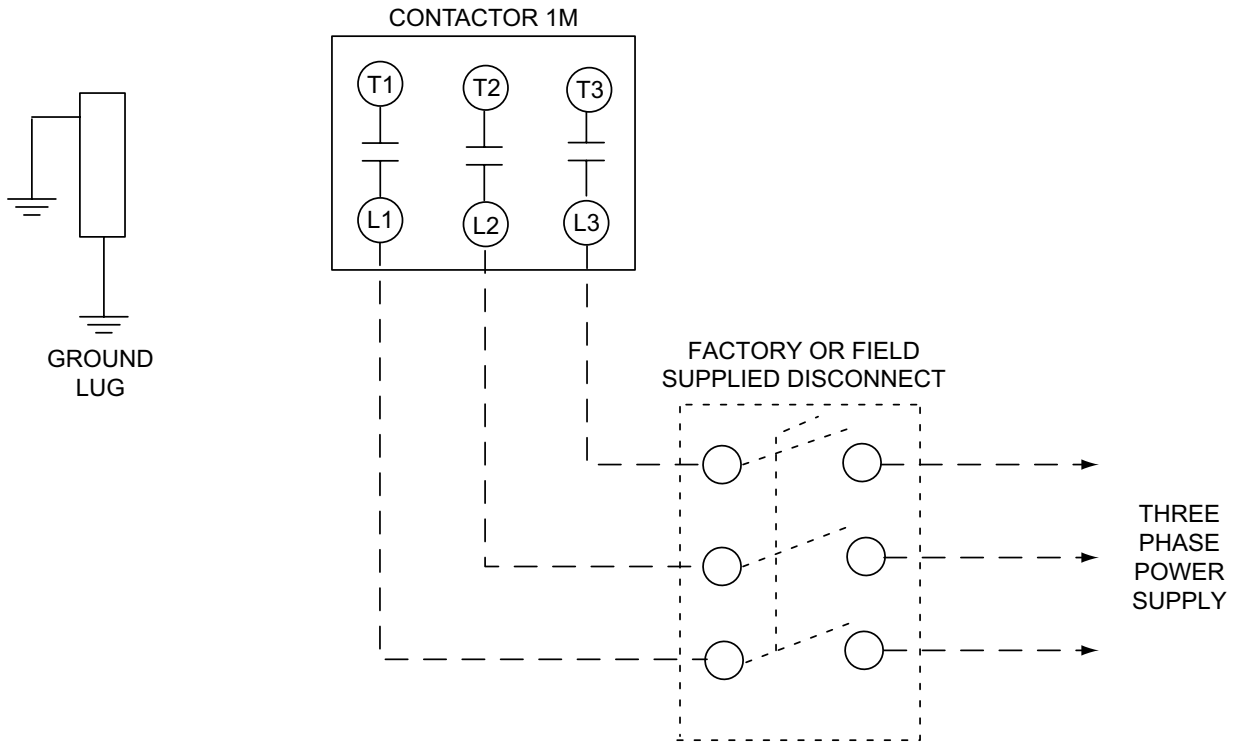


Figure 22: Field Wiring Disconnect - Cooling Unit With Gas Heat

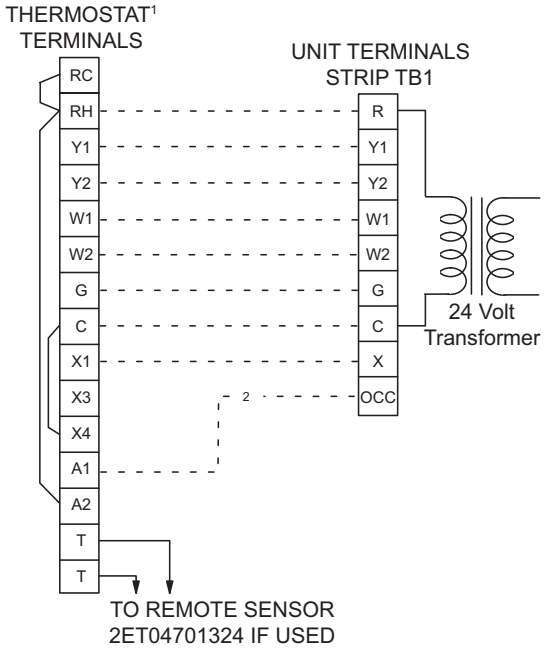
Thermostat Wiring

The thermostat should be located on an inside wall approximately 56 inch above the floor where it will not be subject to drafts, sun exposure or heat from electrical fixtures or appliances. Follow the manufacturer's instructions enclosed with thermostat for general installation procedure. Seven (7) color-coded, insulated wires should be used to connect the thermostat to the unit. Refer to Table 7 for control wire sizing and maximum length.

Table 7: Control Wire Sizes

Wire Size	Maximum Length[1]
18 AWG	150 Feet

1. From the unit to the thermostat and back to the unit.



[1] Electronic programmable Thermostat 2ET0770010024 (includes subbase).
[2] Terminals A1 and A2 provide a relay output to close the outdoor economizer dampers when the thermostat switches to the set-back position.

Figure 23: Electronic Thermostat Field Wiring

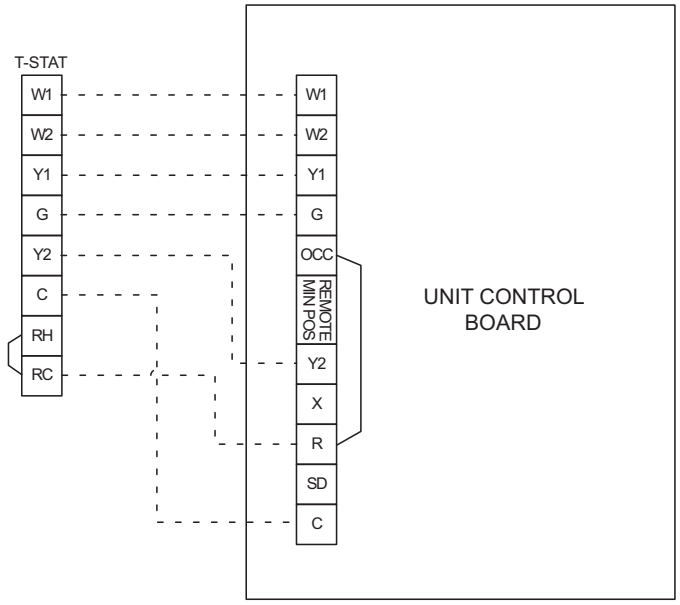


Figure 24: Field Wiring 24 Volt Thermostat

Table 8: Electrical Data

ZH078-150 Standard Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	12.8	95.0	20.0	1.5	6.2	5.5	0.0	None	-	-	-	38.0	43.5	50	50
									E09	6.8	1	18.9	38.0	43.5	50	50
									E18	13.5	2	37.5	54.6	61.5	60	70
									E24	18.0	2	50.0	70.2	77.1	80	80
									E36	25.5	2	70.8	96.2	103.1	100	110
	230	12.8	95.0	20.0	1.5	6.2	5.5	0.0	None	-	-	-	38.0	43.5	50	50
									E09	9.0	1	22.6	38.0	43.5	50	50
									E18	18.0	2	45.2	61.9	68.8	70	70
									E24	24.0	2	60.2	79.9	86.8	80	90
									E36	34.0	2	85.3	110.0	116.9	110	125
	460	6.4	45.0	10.0	0.8	3.1	2.2	0.0	None	-	-	-	19.1	21.3	25	25
									E09	9.0	1	11.3	19.1	21.3	25	25
									E18	18.0	2	22.6	30.9	33.7	35	35
									E24	24.0	2	30.1	40.0	42.7	40	45
									E36	34.0	2	42.7	55.0	57.7	60	60
	575	5.4	38.0	8.5	0.6	2.4	1.8	0.0	None	-	-	-	15.8	17.6	20	20
									E09	9.0	1	9.0	15.8	17.6	20	20
									E18	18.0	2	18.1	24.7	26.9	25	30
									E24	24.0	2	24.1	31.9	34.1	35	35
									E36	34.0	2	34.1	43.9	46.1	45	50
090 (7.5)	208	14.7	115.0	23.0	1.5	8.2	5.5	0.0	None	-	-	-	44.3	49.8	50	60
									E09	6.8	1	18.9	44.3	49.8	50	60
									E18	13.5	2	37.5	57.1	64.0	60	70
									E24	18.0	2	50.0	72.7	79.6	80	80
									E36	25.5	2	70.8	98.7	105.6	100	110
	230	14.7	115.0	23.0	1.5	8.2	5.5	0.0	None	-	-	-	44.3	49.8	50	60
									E09	9.0	1	22.6	44.3	49.8	50	60
									E18	18.0	2	45.2	64.4	71.3	70	80
									E24	24.0	2	60.2	82.4	89.3	90	90
									E36	34.0	2	85.3	112.5	119.4	125	125
	460	7.7	50.0	12.0	0.8	4.1	2.2	0.0	None	-	-	-	23.0	25.2	30	30
									E09	9.0	1	11.3	23.0	25.2	30	30
									E18	18.0	2	22.6	32.2	34.9	35	35
									E24	24.0	2	30.1	41.2	44.0	45	45
									E36	34.0	2	42.7	56.2	59.0	60	60
	575	6.4	40.0	10.0	0.6	3.6	1.8	0.0	None	-	-	-	19.2	21.0	25	25
									E09	9.0	1	9.0	19.2	21.0	25	25
									E18	18.0	2	18.1	26.2	28.4	30	30
									E24	24.0	2	24.1	33.4	35.6	35	40
									E36	34.0	2	34.1	45.4	47.6	50	50
102 (8.5)	208	16.0	120.0	25.0	3.5	8.2	5.5	0.0	None	-	-	-	51.2	56.7	60	70
									E09	6.8	1	18.9	51.2	56.7	60	70
									E18	13.5	2	37.5	57.1	64.0	60	70
									E24	18.0	2	50.0	72.7	79.6	80	80
									E36	25.5	2	70.8	98.7	105.6	100	110
	230	16.0	120.0	25.0	3.5	8.2	5.5	0.0	None	-	-	-	51.2	56.7	60	70
									E09	9.0	1	22.6	51.2	56.7	60	70
									E18	18.0	2	45.2	64.4	71.3	70	80
									E24	24.0	2	60.2	82.4	89.3	90	90
									E36	34.0	2	85.3	112.5	119.4	125	125
	460	8.3	60.0	13.0	1.6	4.1	2.2	0.0	None	-	-	-	26.0	28.2	30	35
									E09	9.0	1	11.3	26.0	28.2	30	35
									E18	18.0	2	22.6	32.2	34.9	35	35
									E24	24.0	2	30.1	41.2	44.0	45	45
									E36	34.0	2	42.7	56.2	59.0	60	60
	575	6.7	40.0	10.5	1.3	3.6	1.8	0.0	None	-	-	-	21.3	23.1	25	25
									E09	9.0	1	9.0	21.3	23.1	25	25
									E18	18.0	2	18.1	26.2	28.4	30	30
									E24	24.0	2	24.1	33.4	35.6	35	40
									E36	34.0	2	34.1	45.4	47.6	50	50

ZH078-150 Standard Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	17.9	120.0	28.0	3.5	8.2	5.5	0.0	None	-	-	-	55.5	61.0	70	70
									E18	13.5	2	37.5	57.1	64.0	70	70
									E24	18.0	2	50.0	72.7	79.6	80	80
									E36	25.5	2	70.8	98.7	105.6	100	110
									E54	40.6	2	112.7	151.1	158.0	175	175
	230	17.9	120.0	28.0	3.5	8.2	5.5	0.0	None	-	-	-	55.5	61.0	70	70
									E18	18.0	2	45.2	64.4	71.3	70	80
									E24	24.0	2	60.2	82.4	89.3	90	90
									E36	34.0	2	85.3	112.5	119.4	125	125
									E54	54.0	2	135.6	140.2	147.0	150	175
	460	9.6	70.0	15.0	1.6	4.1	2.2	0.0	None	-	-	-	28.9	31.1	35	40
									E18	18.0	2	22.6	32.2	34.9	35	40
									E24	24.0	2	30.1	41.2	44.0	45	45
									E36	34.0	2	42.7	56.2	59.0	60	60
									E54	54.0	2	67.8	70.1	72.8	80	80
	575	7.4	53.0	11.5	1.3	3.6	1.8	0.0	None	-	-	-	22.9	24.7	30	30
									E18	18.0	2	18.1	26.2	28.4	30	30
									E24	24.0	2	24.1	33.4	35.6	35	40
									E36	34.0	2	34.1	45.4	47.6	50	50
									E54	54.0	2	54.2	56.5	58.7	70	70
150 (12.5)	208	25.0	149.0	35.0	1.5	10.9	5.5	0.0	None	-	-	-	73.2	78.7	90	100
									E18	13.5	2	37.5	73.2	78.7	90	100
									E24	18.0	2	50.0	76.1	83.0	90	100
									E36	25.5	2	70.8	102.1	109.0	110	110
									E54	40.6	2	112.7	154.5	161.4	175	175
	230	25.0	149.0	35.0	1.5	10.9	5.5	0.0	None	-	-	-	73.2	78.7	90	100
									E18	18.0	2	45.2	73.2	78.7	90	100
									E24	24.0	2	60.2	85.8	92.7	90	100
									E36	34.0	2	85.3	115.9	122.7	125	125
									E54	54.0	2	135.6	143.5	150.4	175	175
	460	11.8	75.0	16.5	0.8	5.3	2.2	0.0	None	-	-	-	35.1	37.3	45	45
									E18	18.0	2	22.6	35.1	37.3	45	45
									E24	24.0	2	30.1	42.7	45.5	45	50
									E36	34.0	2	42.7	57.7	60.5	60	70
									E54	54.0	2	67.8	71.6	74.3	80	80
	575	8.6	54.0	12.0	0.6	4.1	1.8	0.0	None	-	-	-	25.9	27.7	30	35
									E18	18.0	2	18.1	26.8	29.0	30	35
									E24	24.0	2	24.1	34.0	36.2	35	40
									E36	34.0	2	34.1	46.0	48.3	50	50
									E54	54.0	2	54.2	57.1	59.3	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH078-150 Alternate Motor - Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	12.8	95.0	20.0	1.5	8.2	5.5	0.0	None	-	-	-	40.0	45.5	50	50
									E09	6.8	1	18.9	40.0	45.5	50	50
									E18	13.5	2	37.5	57.1	64.0	60	70
									E24	18.0	2	50.0	72.7	79.6	80	80
									E36	25.5	2	70.8	98.7	105.6	100	110
	230	12.8	95.0	20.0	1.5	8.2	5.5	0.0	None	-	-	-	40.0	45.5	50	50
									E09	9.0	1	22.6	40.0	45.5	50	50
									E18	18.0	2	45.2	64.4	71.3	70	80
									E24	24.0	2	60.2	82.4	89.3	90	90
									E36	34.0	2	85.3	112.5	119.4	125	125
	460	6.4	45.0	10.0	0.8	4.1	2.2	0.0	None	-	-	-	20.1	22.3	25	25
									E09	9.0	1	11.3	20.1	22.3	25	25
									E18	18.0	2	22.6	32.2	34.9	35	35
									E24	24.0	2	30.1	41.2	44.0	45	45
									E36	34.0	2	42.7	56.2	59.0	60	60
	575	5.4	38.0	8.5	0.6	3.6	1.8	0.0	None	-	-	-	17.0	18.8	20	20
									E09	9.0	1	9.0	17.0	18.8	20	20
									E18	18.0	2	18.1	26.2	28.4	30	30
									E24	24.0	2	24.1	33.4	35.6	35	40
									E36	34.0	2	34.1	45.4	47.6	50	50
090 (7.5)	208	14.7	115.0	23.0	1.5	10.9	5.5	0.0	None	-	-	-	47.0	52.5	60	60
									E09	6.8	1	18.9	47.0	52.5	60	60
									E18	13.5	2	37.5	60.5	67.3	70	70
									E24	18.0	2	50.0	76.1	83.0	80	90
									E36	25.5	2	70.8	102.1	109.0	110	110
	230	14.7	115.0	23.0	1.5	10.9	5.5	0.0	None	-	-	-	47.0	52.5	60	60
									E09	9.0	1	22.6	47.0	52.5	60	60
									E18	18.0	2	45.2	67.8	74.6	70	80
									E24	24.0	2	60.2	85.8	92.7	90	100
									E36	34.0	2	85.3	115.9	122.7	125	125
	460	7.7	50.0	12.0	0.8	5.3	2.2	0.0	None	-	-	-	24.2	26.4	30	30
									E09	9.0	1	11.3	24.2	26.4	30	30
									E18	18.0	2	22.6	33.7	36.4	35	40
									E24	24.0	2	30.1	42.7	45.5	45	50
									E36	34.0	2	42.7	57.7	60.5	60	70
	575	6.4	40.0	10.0	0.6	4.1	1.8	0.0	None	-	-	-	19.7	21.5	25	25
									E09	9.0	1	9.0	19.7	21.5	25	25
									E18	18.0	2	18.1	26.8	29.0	30	30
									E24	24.0	2	24.1	34.0	36.2	35	40
									E36	34.0	2	34.1	46.0	48.3	50	50
102 (8.5)	208	16.0	120.0	25.0	3.5	10.9	5.5	0.0	None	-	-	-	53.9	59.4	60	70
									E09	6.8	1	18.9	53.9	59.4	60	70
									E18	13.5	2	37.5	60.5	67.3	70	70
									E24	18.0	2	50.0	76.1	83.0	80	90
									E36	25.5	2	70.8	102.1	109.0	110	110
	230	16.0	120.0	25.0	3.5	10.9	5.5	0.0	None	-	-	-	53.9	59.4	60	70
									E09	9.0	1	22.6	53.9	59.4	60	70
									E18	18.0	2	45.2	67.8	74.6	70	80
									E24	24.0	2	60.2	85.8	92.7	90	100
									E36	34.0	2	85.3	115.9	122.7	125	125
	460	8.3	60.0	13.0	1.6	5.3	2.2	0.0	None	-	-	-	27.2	29.4	35	35
									E09	9.0	1	11.3	27.2	29.4	35	35
									E18	18.0	2	22.6	33.7	36.4	35	40
									E24	24.0	2	30.1	42.7	45.5	45	50
									E36	34.0	2	42.7	57.7	60.5	60	70
	575	6.7	40.0	10.5	1.3	4.1	1.8	0.0	None	-	-	-	21.8	23.6	25	30
									E09	9.0	1	9.0	21.8	23.6	25	30
									E18	18.0	2	18.1	26.8	29.0	30	30
									E24	24.0	2	24.1	34.0	36.2	35	40
									E36	34.0	2	34.1	46.0	48.3	50	50

ZH078-150 Alternate Motor - Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	17.9	120.0	28.0	3.5	10.9	5.5	0.0	None	-	-	-	58.2	63.7	70	80
									E18	13.5	2	37.5	60.5	67.3	70	80
									E24	18.0	2	50.0	76.1	83.0	80	90
									E36	25.5	2	70.8	102.1	109.0	110	110
									E54	40.6	2	112.7	154.5	161.4	175	175
	230	17.9	120.0	28.0	3.5	10.9	5.5	0.0	None	-	-	-	58.2	63.7	70	80
									E18	18.0	2	45.2	67.8	74.6	70	80
									E24	24.0	2	60.2	85.8	92.7	90	100
									E36	34.0	2	85.3	115.9	122.7	125	125
									E54	54.0	2	135.6	143.5	150.4	175	175
	460	9.6	70.0	15.0	1.6	5.3	2.2	0.0	None	-	-	-	30.1	32.3	35	40
									E18	18.0	2	22.6	33.7	36.4	35	40
									E24	24.0	2	30.1	42.7	45.5	45	50
									E36	34.0	2	42.7	57.7	60.5	60	70
									E54	54.0	2	67.8	71.6	74.3	80	80
	575	7.4	53.0	11.5	1.3	4.1	1.8	0.0	None	-	-	-	23.4	25.2	30	30
									E18	18.0	2	18.1	26.8	29.0	30	30
									E24	24.0	2	24.1	34.0	36.2	35	40
									E36	34.0	2	34.1	46.0	48.3	50	50
									E54	54.0	2	54.2	57.1	59.3	70	70
150 (12.5)	208	25.0	149.0	35.0	1.5	16.1	5.5	0.0	None	-	-	-	78.4	83.9	100	100
									E18	13.5	2	37.5	78.4	83.9	100	100
									E24	18.0	2	50.0	82.6	89.5	100	100
									E36	25.5	2	70.8	108.6	115.5	110	125
									E54	40.6	2	112.7	161.0	167.9	175	175
	230	25.0	149.0	35.0	1.5	16.1	5.5	0.0	None	-	-	-	78.4	83.9	100	100
									E18	18.0	2	45.2	78.4	83.9	100	100
									E24	24.0	2	60.2	92.3	99.2	100	100
									E36	34.0	2	85.3	122.4	129.2	125	150
									E54	54.0	2	135.6	150.0	156.9	175	175
	460	11.8	75.0	16.5	0.8	8.1	2.2	0.0	None	-	-	-	37.9	40.1	45	50
									E18	18.0	2	22.6	37.9	40.1	45	50
									E24	24.0	2	30.1	46.2	49.0	50	50
									E36	34.0	2	42.7	61.2	64.0	70	70
									E54	54.0	2	67.8	75.1	77.8	90	90
	575	8.6	54.0	12.0	0.6	6.0	1.8	0.0	None	-	-	-	27.8	29.6	35	35
									E18	18.0	2	18.1	29.2	31.4	35	35
									E24	24.0	2	24.1	36.4	38.6	40	40
									E36	34.0	2	34.1	48.4	50.6	50	60
									E54	54.0	2	54.2	59.5	61.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH078-150 Standard Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	12.8	95.0	20.0	1.5	6.2	5.5	10.0	None	–	–	–	48.0	53.5	60	60
									E09	6.8	1	18.9	48.0	53.5	60	60
									E18	13.5	2	37.5	67.1	74.0	70	80
									E24	18.0	2	50.0	82.7	89.6	90	90
									E36	25.5	2	70.8	108.7	115.6	110	125
	230	12.8	95.0	20.0	1.5	6.2	5.5	10.0	None	–	–	–	48.0	53.5	60	60
									E09	9.0	1	22.6	48.0	54.2	60	60
									E18	18.0	2	45.2	74.4	81.3	80	90
									E24	24.0	2	60.2	92.4	99.3	100	100
									E36	34.0	2	85.3	122.5	129.4	125	150
	460	6.4	45.0	10.0	0.8	3.1	2.2	5.0	None	–	–	–	24.1	26.3	30	30
									E09	9.0	1	11.3	24.1	26.4	30	30
									E18	18.0	2	22.6	37.2	39.9	40	40
									E24	24.0	2	30.1	46.2	49.0	50	50
									E36	34.0	2	42.7	61.2	64.0	70	70
	575	5.4	38.0	8.5	0.6	2.4	1.8	4.0	None	–	–	–	19.8	21.6	25	25
									E09	9.0	1	9.0	19.8	21.6	25	25
									E18	18.0	2	18.1	29.7	31.9	30	35
									E24	24.0	2	24.1	36.9	39.1	40	40
									E36	34.0	2	34.1	48.9	51.1	50	60
090 (7.5)	208	14.7	115.0	23.0	1.5	8.2	5.5	10.0	None	–	–	–	54.3	59.8	60	70
									E09	6.8	1	18.9	54.3	59.8	60	70
									E18	13.5	2	37.5	69.6	76.5	70	80
									E24	18.0	2	50.0	85.2	92.1	90	100
									E36	25.5	2	70.8	111.2	118.1	125	125
	230	14.7	115.0	23.0	1.5	8.2	5.5	10.0	None	–	–	–	54.3	59.8	60	70
									E09	9.0	1	22.6	54.3	59.8	60	70
									E18	18.0	2	45.2	76.9	83.8	80	90
									E24	24.0	2	60.2	94.9	101.8	100	110
									E36	34.0	2	85.3	125.0	131.9	125	150
	460	7.7	50.0	12.0	0.8	4.1	2.2	5.0	None	–	–	–	28.0	30.2	35	35
									E09	9.0	1	11.3	28.0	30.2	35	35
									E18	18.0	2	22.6	38.4	41.2	40	45
									E24	24.0	2	30.1	47.5	50.2	50	60
									E36	34.0	2	42.7	62.5	65.2	70	70
	575	6.4	40.0	10.0	0.6	3.6	1.8	4.0	None	–	–	–	23.2	25.0	25	30
									E09	9.0	1	9.0	23.2	25.0	25	30
									E18	18.0	2	18.1	31.2	33.4	35	35
									E24	24.0	2	24.1	38.4	40.6	40	45
									E36	34.0	2	34.1	50.4	52.6	60	60
102 (8.5)	208	16.0	120.0	25.0	3.5	8.2	5.5	10.0	None	–	–	–	61.2	66.7	70	80
									E09	6.8	1	18.9	61.2	66.7	70	80
									E18	13.5	2	37.5	69.6	76.5	70	80
									E24	18.0	2	50.0	85.2	92.1	90	100
									E36	25.5	2	70.8	111.2	118.1	125	125
	230	16.0	120.0	25.0	3.5	8.2	5.5	10.0	None	–	–	–	61.2	66.7	70	80
									E09	9.0	1	22.6	61.2	66.7	70	80
									E18	18.0	2	45.2	76.9	83.8	80	90
									E24	24.0	2	60.2	94.9	101.8	100	110
									E36	34.0	2	85.3	125.0	131.9	125	150
	460	8.3	60.0	13.0	1.6	4.1	2.2	5.0	None	–	–	–	31.0	33.2	35	40
									E09	9.0	1	11.3	31.0	33.2	35	40
									E18	18.0	2	22.6	38.4	41.2	40	45
									E24	24.0	2	30.1	47.5	50.2	50	60
									E36	34.0	2	42.7	62.5	65.2	70	70
	575	6.7	40.0	10.5	1.3	3.6	1.8	4.0	None	–	–	–	25.3	27.1	30	30
									E09	9.0	1	9.0	25.3	27.1	30	30
									E18	18.0	2	18.1	31.2	33.4	35	35
									E24	24.0	2	24.1	38.4	40.6	40	45
									E36	34.0	2	34.1	50.4	52.6	60	60

ZH078-150 Standard Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	17.9	120.0	28.0	3.5	8.2	5.5	10.0	None	–	–	–	65.5	71.0	80	80
									E18	13.5	2	37.5	69.6	76.5	80	80
									E24	18.0	2	50.0	85.2	92.1	90	100
									E36	25.5	2	70.8	111.2	118.1	125	125
									E54	40.6	2	112.7	163.6	170.5	175	175
	230	17.9	120.0	28.0	3.5	8.2	5.5	10.0	None	–	–	–	65.5	71.0	80	80
									E18	18.0	2	45.2	76.9	83.8	80	90
									E24	24.0	2	60.2	94.9	101.8	100	110
									E36	34.0	2	85.3	125.0	131.9	125	150
									E54	54.0	2	135.6	152.7	159.5	175	175
	460	9.6	70.0	15.0	1.6	4.1	2.2	5.0	None	–	–	–	33.9	36.1	40	45
									E18	18.0	2	22.6	38.4	41.2	40	45
									E24	24.0	2	30.1	47.5	50.2	50	60
									E36	34.0	2	42.7	62.5	65.2	70	70
									E54	54.0	2	67.8	76.3	79.1	90	90
	575	7.4	53.0	11.5	1.3	3.6	1.8	4.0	None	–	–	–	26.9	28.7	30	35
									E18	18.0	2	18.1	31.2	33.4	35	35
									E24	24.0	2	24.1	38.4	40.6	40	45
									E36	34.0	2	34.1	50.4	52.6	60	60
									E54	54.0	2	54.2	61.5	63.7	70	70
150 (12.5)	208	25.0	149.0	35.0	1.5	10.9	5.5	10.0	None	–	–	–	83.2	88.7	100	110
									E18	13.5	2	37.5	83.2	88.7	100	110
									E24	18.0	2	50.0	88.6	95.5	100	110
									E36	25.5	2	70.8	114.6	121.5	125	125
									E54	40.6	2	112.7	167.0	173.9	175	175
	230	25.0	149.0	35.0	1.5	10.9	5.5	10.0	None	–	–	–	83.2	88.7	100	110
									E18	18.0	2	45.2	83.2	88.7	100	110
									E24	24.0	2	60.2	98.3	105.2	100	110
									E36	34.0	2	85.3	128.4	135.2	150	150
									E54	54.0	2	135.6	156.0	162.9	175	175
	460	11.8	75.0	16.5	0.8	5.3	2.2	5.0	None	–	–	–	40.1	42.3	50	50
									E18	18.0	2	22.6	40.1	42.7	50	50
									E24	24.0	2	30.1	49.0	51.7	50	60
									E36	34.0	2	42.7	64.0	66.7	70	70
									E54	54.0	2	67.8	77.8	80.6	90	90
	575	8.6	54.0	12.0	0.6	4.1	1.8	4.0	None	–	–	–	29.9	31.7	35	40
									E18	18.0	2	18.1	31.8	34.0	35	40
									E24	24.0	2	24.1	39.0	41.2	40	45
									E36	34.0	2	34.1	51.0	53.3	60	60
									E54	54.0	2	54.2	62.1	64.3	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZH078-150 Alternate Motor - With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
078 (6.5)	208	12.8	95.0	20.0	1.5	6.2	5.5	10.0	None	–	–	–	50.0	55.5	60	60
									E09	6.8	1	18.9	50.0	55.5	60	60
									E18	13.5	2	37.5	69.6	76.5	70	80
									E24	18.0	2	50.0	85.2	92.1	90	100
									E36	25.5	2	70.8	111.2	118.1	125	125
	230	12.8	95.0	20.0	1.5	6.2	5.5	10.0	None	–	–	–	50.0	55.5	60	60
									E09	9.0	1	22.6	50.0	56.7	60	60
									E18	18.0	2	45.2	76.9	83.8	80	90
									E24	24.0	2	60.2	94.9	101.8	100	110
									E36	34.0	2	85.3	125.0	131.9	125	150
	460	6.4	45.0	10.0	0.8	3.1	2.2	5.0	None	–	–	–	25.1	27.3	30	30
									E09	9.0	1	11.3	25.1	27.7	30	30
									E18	18.0	2	22.6	38.4	41.2	40	45
									E24	24.0	2	30.1	47.5	50.2	50	60
									E36	34.0	2	42.7	62.5	65.2	70	70
	575	5.4	38.0	8.5	0.6	2.4	1.8	4.0	None	–	–	–	21.0	22.8	25	25
									E09	9.0	1	9.0	21.0	22.8	25	25
									E18	18.0	2	18.1	31.2	33.4	35	35
									E24	24.0	2	24.1	38.4	40.6	40	45
									E36	34.0	2	34.1	50.4	52.6	60	60
090 (7.5)	208	14.7	115.0	23.0	1.5	8.2	5.5	10.0	None	–	–	–	57.0	62.5	70	70
									E09	6.8	1	18.9	57.0	62.5	70	70
									E18	13.5	2	37.5	73.0	79.8	80	80
									E24	18.0	2	50.0	88.6	95.5	90	100
									E36	25.5	2	70.8	114.6	121.5	125	125
	230	14.7	115.0	23.0	1.5	8.2	5.5	10.0	None	–	–	–	57.0	62.5	70	70
									E09	9.0	1	22.6	57.0	62.5	70	70
									E18	18.0	2	45.2	80.3	87.1	90	90
									E24	24.0	2	60.2	98.3	105.2	100	110
									E36	34.0	2	85.3	128.4	135.2	150	150
	460	7.7	50.0	12.0	0.8	4.1	2.2	5.0	None	–	–	–	29.2	31.4	35	35
									E09	9.0	1	11.3	29.2	31.4	35	35
									E18	18.0	2	22.6	39.9	42.7	40	45
									E24	24.0	2	30.1	49.0	51.7	50	60
									E36	34.0	2	42.7	64.0	66.7	70	70
	575	6.4	40.0	10.0	0.6	3.6	1.8	4.0	None	–	–	–	23.7	25.5	30	30
									E09	9.0	1	9.0	23.7	25.5	30	30
									E18	18.0	2	18.1	31.8	34.0	35	35
									E24	24.0	2	24.1	39.0	41.2	40	45
									E36	34.0	2	34.1	51.0	53.3	60	60
102 (8.5)	208	16.0	120.0	25.0	3.5	8.2	5.5	10.0	None	–	–	–	63.9	69.4	70	80
									E09	6.8	1	18.9	63.9	69.4	70	80
									E18	13.5	2	37.5	73.0	79.8	80	80
									E24	18.0	2	50.0	88.6	95.5	90	100
									E36	25.5	2	70.8	114.6	121.5	125	125
	230	16.0	120.0	25.0	3.5	8.2	5.5	10.0	None	–	–	–	63.9	69.4	70	80
									E09	9.0	1	22.6	63.9	69.4	70	80
									E18	18.0	2	45.2	80.3	87.1	90	90
									E24	24.0	2	60.2	98.3	105.2	100	110
									E36	34.0	2	85.3	128.4	135.2	150	150
	460	8.3	60.0	13.0	1.6	4.1	2.2	5.0	None	–	–	–	32.2	34.4	40	40
									E09	9.0	1	11.3	32.2	34.4	40	40
									E18	18.0	2	22.6	39.9	42.7	40	45
									E24	24.0	2	30.1	49.0	51.7	50	60
									E36	34.0	2	42.7	64.0	66.7	70	70
	575	6.7	40.0	10.5	1.3	3.6	1.8	4.0	None	–	–	–	25.8	27.6	30	30
									E09	9.0	1	9.0	25.8	27.6	30	30
									E18	18.0	2	18.1	31.8	34.0	35	35
									E24	24.0	2	24.1	39.0	41.2	40	45
									E36	34.0	2	34.1	51.0	53.3	60	60

ZH078-150 Alternate Motor - With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Exh Motor	Pwt Conv Outlet	Electric Heat Option				MCA[1] (Amps)	MCA[1] w/Pwr Exh (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)	Max Fuse[2]/ Breaker[3] Size w/ Pwr Exh (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	FLA	Model	kW	Stages	Amps				
120 (10)	208	17.9	120.0	28.0	3.5	8.2	5.5	10.0	None	–	–	–	68.2	73.7	80	90
									E18	13.5	2	37.5	73.0	79.8	80	90
									E24	18.0	2	50.0	88.6	95.5	90	100
									E36	25.5	2	70.8	114.6	121.5	125	125
									E54	40.6	2	112.7	167.0	173.9	175	175
	230	17.9	120.0	28.0	3.5	8.2	5.5	10.0	None	–	–	–	68.2	73.7	80	90
									E18	18.0	2	45.2	80.3	87.1	90	90
									E24	24.0	2	60.2	98.3	105.2	100	110
									E36	34.0	2	85.3	128.4	135.2	150	150
									E54	54.0	2	135.6	156.0	162.9	175	175
	460	9.6	70.0	15.0	1.6	4.1	2.2	5.0	None	–	–	–	35.1	37.3	40	45
									E18	18.0	2	22.6	39.9	42.7	40	45
									E24	24.0	2	30.1	49.0	51.7	50	60
									E36	34.0	2	42.7	64.0	66.7	70	70
									E54	54.0	2	67.8	77.8	80.6	90	90
	575	7.4	53.0	11.5	1.3	3.6	1.8	4.0	None	–	–	–	27.4	29.2	30	35
									E18	18.0	2	18.1	31.8	34.0	35	35
									E24	24.0	2	24.1	39.0	41.2	40	45
									E36	34.0	2	34.1	51.0	53.3	60	60
									E54	54.0	2	54.2	62.1	64.3	70	70
150 (12.5)	208	25.0	149.0	35.0	1.5	10.9	5.5	10.0	None	–	–	–	88.4	93.9	110	110
									E18	13.5	2	37.5	88.4	93.9	110	110
									E24	18.0	2	50.0	95.1	102.0	110	110
									E36	25.5	2	70.8	121.1	128.0	125	150
									E54	40.6	2	112.7	173.5	180.4	175	200
	230	25.0	149.0	35.0	1.5	10.9	5.5	10.0	None	–	–	–	88.4	93.9	110	110
									E18	18.0	2	45.2	88.4	93.9	110	110
									E24	24.0	2	60.2	104.8	111.7	110	125
									E36	34.0	2	85.3	134.9	141.7	150	150
									E54	54.0	2	135.6	162.5	169.4	175	175
	460	11.8	75.0	16.5	0.8	5.3	2.2	5.0	None	–	–	–	42.9	45.1	50	50
									E18	18.0	2	22.6	43.4	46.2	50	50
									E24	24.0	2	30.1	52.5	55.2	60	60
									E36	34.0	2	42.7	67.5	70.2	70	80
									E54	54.0	2	67.8	81.3	84.1	90	90
	575	8.6	54.0	12.0	0.6	4.1	1.8	4.0	None	–	–	–	31.8	33.6	40	40
									E18	18.0	2	18.1	34.2	36.4	40	40
									E24	24.0	2	24.1	41.4	43.6	45	45
									E36	34.0	2	34.1	53.4	55.6	60	60
									E54	54.0	2	54.2	64.5	66.7	70	70

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

Table 9: ZH078-150 Physical Data

Component	Models									
	ZH078		ZH090		ZH102		ZH120		ZH150	
Nominal Tonnage	**6.5**		**7.5**		**8.5**		**10**		**12.5**	
ARI COOLING PERFORMANCE										
Gross Capacity @ ARI A point (Btu)	79000		93000		106000		126000		156000	
ARI net capacity (Btu)	76000		90000		102000		122000		150000	
EER	11.4		11.4		11.5		11.5		11.2	
SEER	-		-		-		-		-	
IPLV	12.7		12.4		12.4		12.1		12.7	
Nominal CFM	2600		3000		3400		4000		5000	
System power (KW)	6.67		7.90		8.87		10.61		13.40	
Refrigerant type	R-410a		R-410a		R-410a		R-410a		R-410a	
Refrigerant charge (lb-oz)										
System 1	9-4		8-8		11-8		11-8		19-8	
System 2	6-0		8-4		11-0		11-8		19-8	
ARI HEATING PERFORMANCE										
Heating model	10	15	10	15	10	15	15	20	15	20
Heat input (K Btu)	120	180	120	180	120	180	180	240	180	240
Heat output (K Btu)	96	144	96	144	96	144	144	192	144	192
AFUE %	-	-	-	-	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80	80	80	80	80
No. burners	4	6	4	6	4	6	6	8	6	8
No. stages	2	2	2	2	2	2	2	2	2	2
Temperature Rise Range (ºF)	20-50	35-65	15-45	30-60	10-40	25-55	20-50	35-65	10-40	25-55
Gas Limit Setting (ºF)	165	165	165	165	215	195	195	160	195	160
Gas piping connection (in.)	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
DIMENSIONS (inches)										
Length	89		89		89		89		119-7/16	
Width	59		59		59		59		59	
Height	42		42		50-3/4		50-3/4		50-3/4	
OPERATING WT. (lbs.)	900		920		1135		1135		1400	
COMPRESSORS										
Type	Scroll		Scroll		Scroll		Scroll		Scroll	
Quantity	2		2		2		2		2	
Unit Capacity Steps (%)	50 / 100		50 / 100		50 / 100		50 / 100		50 / 100	
CONDENSER COIL DATA										
Face area (Sq. Ft.)	23.8		23.8		29.0		29.0		47.5	
Rows	2 / 1		2		2		2		2	
Fins per inch	20		20		20		20		15	
Tube diameter (in.)	3/8		3/8		3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face		Split-face		Split-face	
EVAPORATOR COIL DATA										
Face area (Sq. Ft.)	10.6		10.6		13.2		13.2		13.2	
Rows	3		3		4		4		4	
Fins per inch	15		15		15		15		15	
Tube diameter	0.375		0.375		0.375		0.375		0.375	
Circuitry Type	Split-face		Split-face		Split-face		Split-face		Split-face	
Refrigerant control	TXV		TXV		TXV		TXV		TXV	

Table 9: ZH078-150 Physical Data (Continued)

Component	Models									
	ZH078		ZH090		ZH102		ZH120		ZH150	
Nominal Tonnage	6.5		7.5		8.5		10		12.5	
CONDENSER FAN DATA										
Quantity	2		2		2		2		4	
Fan diameter (Inch)	24		24		24		24		24	
Type	Prop		Prop		Prop		Prop		Prop	
Drive type	Direct		Direct		Direct		Direct		Direct	
No. speeds	1		1		1		1		1	
Number of motors	2		2		2		2		4	
Motor HP each	1/3		1/3		3/4		3/4		1/3	
RPM	850		850		1110		1110		850	
Nominal total CFM	6800		6800		8800		8800		14000	
BELT DRIVE EVAP FAN DATA										
Quantity	1		1		1		1		1	
Fan Size (Inch)	12 x 12		12 x 12		15 x 15		15 x 15		15 x 15	
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		Centrifugal	
Motor Sheave	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VM50	1VP56
Blower Sheave	AK74	AK66	AK69	AK64	AK89	AK74	AK84	AK74	AK74	BK77
Belt	A49	A49	A49	A49	A56	A54	A56	A54	A54	BX55
Motor HP each	1-1/2	2	2	3	2	3	2	3	3	5
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	56	56	56	56	56	56	56	56	56	184T
FILTERS										
Quantity - Size	4 - 25 x 16 x 2		4 - 25 x 16 x 2		4 - 25 x 20 x 2		4 - 25 x 20 x 2		4 - 25 x 20 x 2	

Optional Electric Heat

The factory-installed heaters are wired for single point power supply. Power supply need only be brought into the single point terminal block.

These CSA approved heaters are located within the central compartment of the unit with the heater elements extending in to the supply air chamber.

Fuses are supplied, where required, by the factory. Some kW sizes require fuses and others do not. refer to Table 10 for minimum CFM limitations and to Table 8 for electrical data.

Table 10: Electric Heat Minimum Supply Air

Size (Tons)	Model	Voltage	Minimum Supply Air (CFM)				
			Heater kW				
			9	18	24	36	54
078 (6.5)	ZH	208/230-3-60	1950	1950	1950	1950	-
		460-3-60	1950	1950	1950	1950	-
		600-3-60	1950	1950	1950	1950	-
090 (7.5)	ZH	208/230-3-60	2250	2250	2250	2250	-
		460-3-60	2250	2250	2250	2250	-
		600-3-60	2250	2250	2250	2250	-
102 (8.5)	ZH	208/230-3-60	2550	2550	2550	2550	-
		460-3-60	2550	2550	2550	2550	-
		600-3-60	2550	2550	2550	2550	-
120 (10)	ZH	208/230-3-60	-	3000	3000	3000	3500
		460-3-60	-	3000	3000	3000	3000
		600-3-60	-	3000	3000	3000	3500
150 (12.5)	ZH	208/230-3-60	-	3750	3750	3750	4000
		460-3-60	-	3750	3750	3750	3750
		600-3-60	-	3750	3750	3750	3750

Optional Gas Heat

These gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition.

Table 11: Gas Application Data

Unit		Input (MBH)	Output (MBH)	Temp Rise (°F)
Size	Opt.			
078	10	120	96	20-50
	15	180	144	35-65
090	10	120	96	15-45
	15	180	144	30-60
102	10	120	96	10-40
	15	180	144	25-55
120	15	180	144	20-50
	20	240	192	35-65
150	15	180	144	10-40
	20	240	192	25-55

Gas Piping

Proper sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas and the length of run. "National Fuel Gas Code" Z223.1 (in U.S.A.) or the current Gas Installation Codes CSA-B149.1 (in Canada) should be followed in all cases unless superseded by local codes or gas utility requirements. Refer to the Pipe Sizing Table 12. The heating value of the gas may differ with locality. The value should be checked with the local gas utility.

NOTE: There may be a local gas utility requirement specifying a minimum diameter for gas piping. All units require a one-inch pipe connection at the entrance fitting.

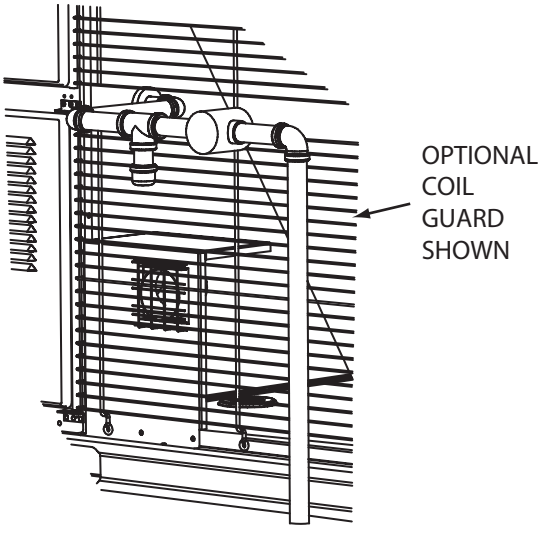


Figure 25: Side Entry Gas Piping

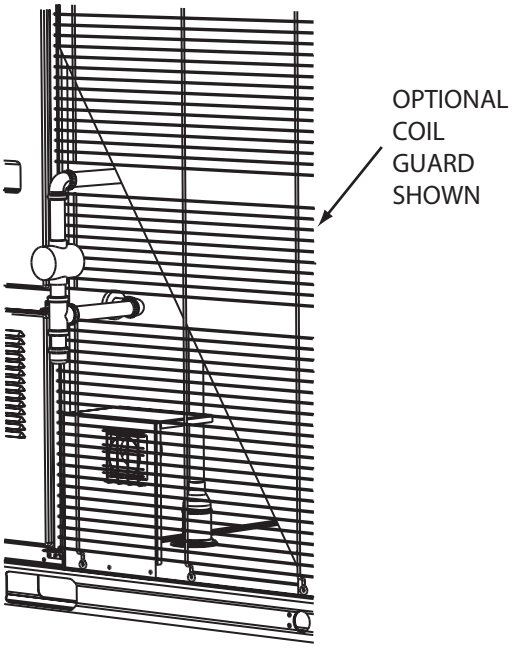


Figure 26: Bottom Entry Gas Piping

Table 12: Gas Pipe Sizing - Capaclty of Pipe

Length of Pipe (ft.)	Nominal Iron Pipe Size		
	3/4 in.	1 in.	1-1/4 in.
10	278	520	1050
20	190	350	730
30	152	285	590
40	130	245	500
50	115	215	440
60	105	195	400
70	96	180	370
80	90	170	350
90	84	160	320
100	79	150	305

NOTE: Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of 0.3 inch W.C. and 0.6 specific gravity gas.

NOTE: There may be a local gas utility requirement specifying a minimum diameter for gas piping. All units require a 3/4 inch pipe connection at the entrance fitting. Line should not be sized smaller than the entrance fitting size.

Table 13: Gas Heat Minimum Supply Air

Size (Tons)	Model	Heat Size	Supply Air (CFM)			
			Cooling		Heating	
			Min	Max	Min	Max
078 (6.5)	ZH	10	1950	3250	1950	3250
		15	1950	3250	1950	3250
090 (7.5)	ZH	10	2250	3750	2250	3750
		15	2250	3750	2250	3750
102 (8.5)	ZH	10	2550	4250	2550	4250
		15	2550	4250	2550	4250
120 (10)	ZH	15	3000	5000	3000	5000
		20	3000	5000	3000	5000
150 (12.5)	ZH	15	3750	6250	3750	6250
		20	3750	6250	3750	6250

Gas Connection

The gas supply line can be routed within the space and roof curb, exiting through the unit's basepan. Refer to Figures 8 and 9 for the gas piping inlet location. Typical supply piping arrangements are shown in Figures 25 and 26. All pipe nipples, fittings, and the gas cock are field supplied or may be purchased in UPG accessory kit #1GP0405.

Gas piping recommendations:

1. A drip leg and a ground joint union must be installed in the gas piping.
2. Where required by local codes, a manual shut-off valve must be installed outside of the unit.
3. Use wrought iron or steel pipe for all gas lines. Pipe dope should be applied sparingly to male threads only.

⚠WARNING

Natural gas may contain some propane. Propane is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe. Shellac based compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clydes's or John Crane may be used.

4. All piping should be cleaned of dirt and scale by hammering on the outside of the pipe and blowing out loose particles. Before initial start-up, be sure that all gas lines external to the unit have been purged of air.
5. The gas supply should be a separate line and installed in accordance with all safety codes as prescribed under "Limitations".
6. A 1/8-inch NPT plugged tapping, accessible for test gage connection, must be installed immediately upstream of the gas supply connection to the unit.
7. After the gas connections have been completed, open the main shut-off valve admitting *normal gas pressure* to the mains. *Check all joints for leaks with soap solution or other material suitable for the purpose.* **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

⚠ CAUTION

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

⚠WARNING

Threaded joints should be coated with a sealing compound that is resistant to the action of liquefied petroleum gases. **Do not use Teflon tape.**

Lp Units, Tanks And Piping

All gas heat units are shipped from the factory equipped for natural gas use only. The unit may be converted in the field for use with LP gas with accessory kit model number 1NP0442.

All LP gas equipment must conform to the safety standards of the National Fire Protection Association.

For satisfactory operation, LP gas pressure must be 10.5 inch W.C. at the unit under full load. Maintaining proper gas pressure depends on three main factors:

1. The vaporization rate which depends on the temperature of the liquid and the “wetted surface” area of the container(s).
2. The proper pressure regulation. (Two-stage regulation is recommended).
3. The pressure drop in the lines between regulators and between the second stage regulator and the appliance. Pipe size required will depend on the length of the pipe run and the total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and LP gas suppliers.

⚠WARNING

LP gas is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe for LP. Shellac base compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clyde’s, or John Crane may be used.

Check all connections for leaks when piping is completed using a soap solution. **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Vent And Combustion Air

Venting slots in the heating compartment access panel remove the need for a combustion air hood. The gas heat flue exhaust is routed through factory installed exhaust piping with screen. If necessary, a flue exhaust extension may be installed at the point of installation.

Options/Accessories

Electric Heat

Electric heaters are available as factory-installed options or field-installed accessories. Refer to electric heat instructions for installation. These heaters mount in the heat compartment with the heating elements extending into the supply air chamber. All electric heaters are fused and intended for use with single point power supply.

Motorized Outdoor Damper

The Motorized Outdoor Damper can be a factory installed option or a field installed accessory. If factory installed, refer to the instructions included with the outdoor air hood to complete the assembly. Field installed Motorized Outdoor Damper accessories include complete instructions for installation.

Economizer

The Economizer can be a factory installed option or a field installed accessory. If factory installed, refer to the instructions included with the outdoor air hood to complete the assembly. Field installed Economizer accessories include complete instructions for installation.

There are two Economizer options:

1. Down Flow application with barometric relief hood standard.
2. Horizontal Flow application that requires the purchase of a barometric relief hood.

Power Exhaust

The Power Exhaust can be a factory installed option or a field installed accessory. If factory installed, refer to the instructions included with the outdoor air hood to complete the assembly. Field installed Power Exhaust accessories include complete instructions for installation.

The Power Exhaust factory installed option is for Down Flow application only.

There are two field installed Power Exhaust accessories:

1. Down Flow application.
2. Horizontal Flow application that requires the purchase of a barometric relief hood.

Rain Hood

All of the hood components, including the filters, the gasketing and the hardware for assembling, are packaged and located between the condenser coil section and the main unit cabinet, if the unit has factory installed options. If field installed accessories are being installed all parts necessary for the installation comes in the accessory.

Economizer And Power Exhaust Set Point Adjustments

Remove the top rear access panel from the unit. Locate the economizer control module, where the following adjustments will be made.

⚠ CAUTION

Extreme care must be exercised in turning all set point, maximum and minimum damper positioning adjustment screws to prevent twisting them off.

Minimum Position Adjustment

- Check that the damper blades move smoothly without binding; carefully turn the Minimum Position Adjust screw (found on the damper control module) fully clockwise and then set the thermostat indoor fan switch to the ON position and then OFF or energize and de-energize terminals “R” to “G”.
- With the thermostat set to the indoor fan ON position or terminals “R” to “G” energized, turn the Minimum Position Adjusting screw (located on the damper control module) counterclockwise until the desired minimum damper position has been attained.

Enthalpy Set Point Adjustment

- The enthalpy set point may now be set by selecting the desired set point shown in the Enthalpy Set Point Adjustment Figure 27. Adjust as follows:
- For a single enthalpy operation carefully turn the set point adjusting screw (found on the damper control module) to the "A", "B", "C" or "D" setting corresponding to the lettered curve of the Enthalpy Set Point Adjustment Figure 28.
- For a dual enthalpy operation, carefully turn the set point adjusting screw fully clockwise past the "D" setting.

Power Exhaust Damper Set Point (With Or Without Power Exhaust)

- With no power exhaust option, adjust the Exhaust Air Adjustment Screw fully clockwise. This will allow 2nd stage cooling to operate.
- With power exhaust option, each building pressurization requirement will be different. The point at which the power exhaust comes on is determined by the economizer damper position (Percent Open). The Exhaust Air Adjustment Screw should be set at the Percent Open of the economizer damper at which the power exhaust is needed. It can be set from 0 to 100% damper open.

Indoor Air Quality AQ

Indoor Air Quality (indoor sensor input): Terminal AQ accepts a +2 to +10 Vdc signal with respect to the (AQ1) terminal. When the signal is below it's set point, the actuator is allowed to modulate normally in accordance with the enthalpy and mixed air sensor inputs. When the AQ signal exceeds it's set point setting and there is no call for free cooling, the actuator is proportionately modulated from the 2 to 10 Vdc signal, with 2 Vdc corresponding to full closed and 10 Vdc corresponding to full open. When there is no call for free cooling, the damper position is limited by the IAQ Max damper position setting. When the signal exceeds it's set point (Demand Control Ventilation Set Point) setting and there is a call for free cooling, the actuator modulates from the minimum position to the full open position based on the highest call from either the mixed air sensor input or the AQ voltage input.

- Optional CO_2 Space Sensor Kit Part # 2AQ04700324
- Optional CO_2 Sensor Kit Part # 2AQ04700424

Replace the top rear access panel on the unit.

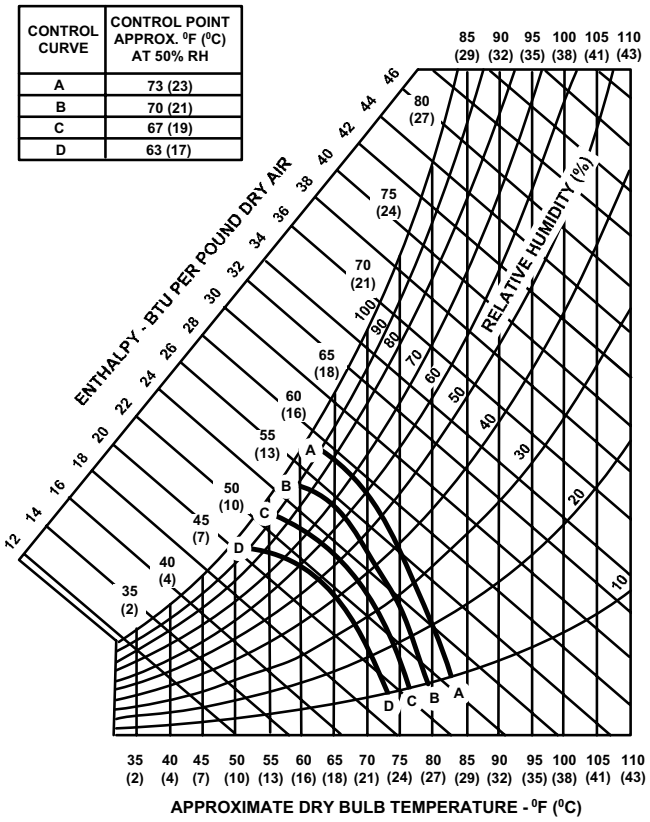

CONTROL CURVE
CONTROL POINT APPROX. °F (°C) AT 50% RH
A 73 (23)
B 70 (21)
C 67 (19)
D 63 (17)
ENTHALPY - BTU PER POUND DRY AIR
RELATIVE HUMIDITY (%)
APPROXIMATE DRY BULB TEMPERATURE - °F (°C)

Figure 27: Enthalpy Set Point Chart

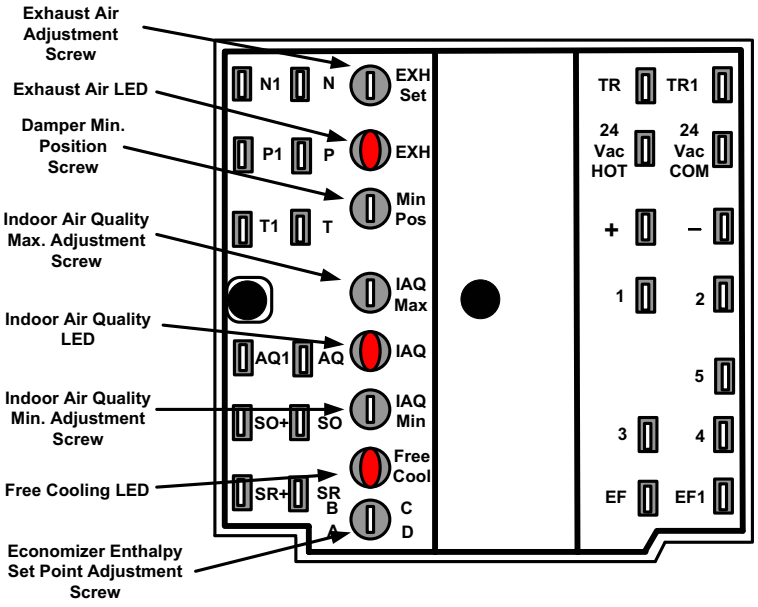


Figure 28: Honeywell Economizer Control W7212

Phasing

Predator® units are properly phased at the factory. Check for proper compressor rotation. If the blower or compressors rotate in the wrong direction at start-up, the electrical connection to the unit is misphased. Change the phasing of the **Field Line Connection at the factory or field supplied disconnect** to obtain proper rotation. (Scroll compressors operate in only one direction. If the scroll is drawing low amperage, has similar suction and discharge pressures, or producing a high noise level, the scroll is misphased.)

⚠ CAUTION

Scroll compressors require proper rotation to operate correctly. Units are properly phased at the factory. Do not change the internal wiring to make the blower condenser fans, or compressor rotate correctly.

Blower Rotation

Check for proper supply air blower rotation. If the blower is rotating backwards, the line voltage at the unit point of power connection is misphased (See 'PHASING').

Table 14: Supply Air Limitations

Unit Size (Ton)	Minimum	Maximum
078 (6.5)	1950	3250
090 (7.5)	2250	3750
102 (8.5)	2550	4250
120 (10)	3000	5000
150 (12.5)	3750	6250

Belt Tension

The tension on the belt should be adjusted as shown in Figure 29.

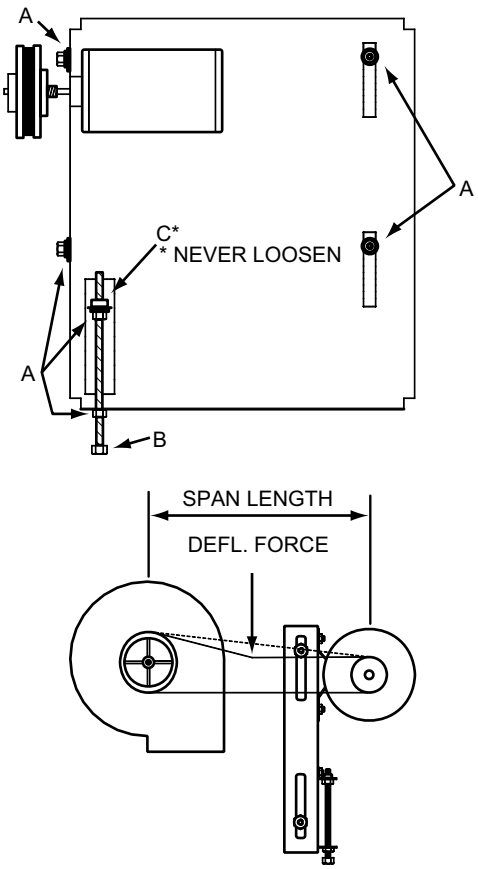


Figure 29: Belt Adjustment

⚠ CAUTION

Procedure for adjusting belt tension:

1. Loosen six nuts (top and bottom) A.
2. Adjust by turning (B).
3. Never loosen nuts (C).
4. Use belt tension checker to apply a perpendicular force to one belt at the midpoint of the span as shown. Deflection distance of 4mm (5/32") is obtained.

To determine the deflection distance from normal position, use a straight edge from sheave to sheave as reference line. The recommended deflection force is as follows:

Tension new belts at the max. deflection force recommended for the belt section. Check the belt tension at least two times during the first 24 hours of operation. Any retensioning should fall between the min. and max. deflection force values.

5. After adjusting retighten nuts (A).

CFM Static Pressure and Power-Altitude and Temperature Corrections

The information below should be used to assist in application of product when being applied at altitudes at or exceeding 1000 feet above sea level.

The air flow rates listed in the standard blower performance tables are based on standard air at sea level. As the altitude or temperature increases, the density of air decreases. In order to use the indoor blower tables for high altitude applications, certain corrections are necessary.

A centrifugal fan is a "constant volume" device. This means that, if the rpm remains constant, the CFM delivered is the same regardless of the density of the air. However, since the air at high altitude is less dense, less static pressure will be generated and less power will be required than a similar application at sea level. Air density correction factors are shown in Table 15 and Figure 30.

Table 15: Altitude/Temperature Correction Factors

Air Temp.	Altitude (Ft.)										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651

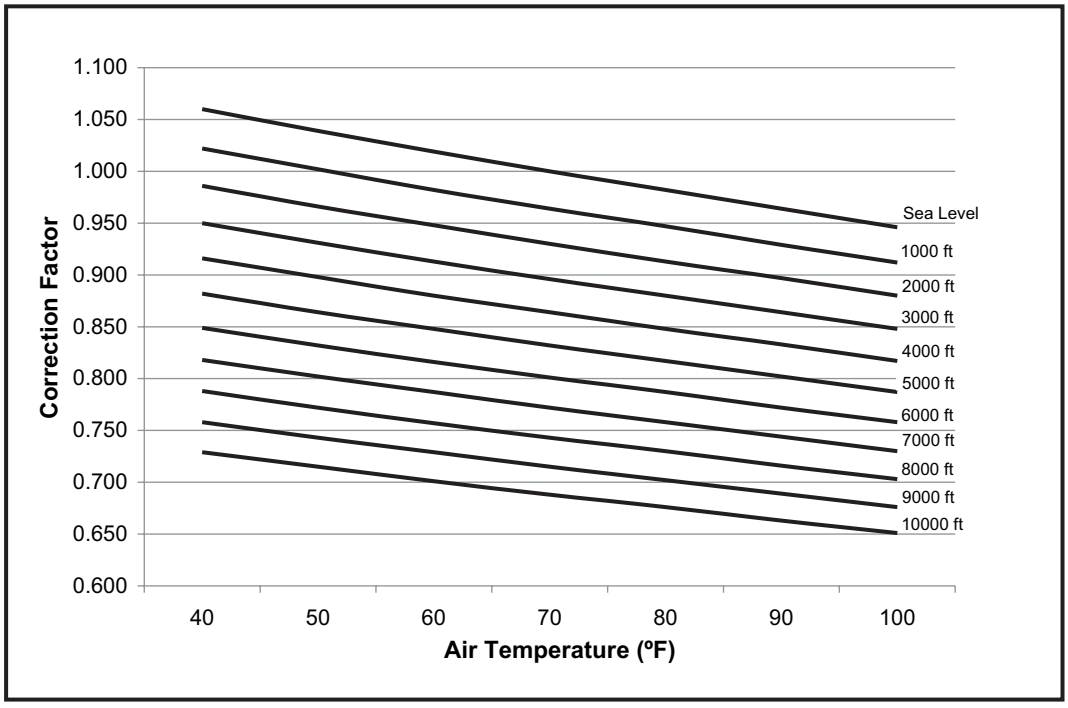


Figure 30: Altitude/Temperature Correction Factors

The examples below will assist in determining the airflow performance of the product at altitude.

Example 1: What are the corrected CFM, static pressure, and BHP at an elevation of 5,000 ft. if the blower performance data is 6,000 CFM, 1.5 IWC and 4.0 BHP?

Solution: At an elevation of 5,000 ft. the indoor blower will still deliver 6,000 CFM if the rpm is unchanged. However, Table 14 must be used to determine the static pressure and BHP. Since no temperature data is given, we will assume an air temperature of 70°F. Table 16 shows the correction factor to be 0.832.

Corrected static pressure = 1.5 x 0.832 = 1.248 IWC

Corrected BHP = 4.0 x 0.832 = 3.328

Example 2: A system, located at 5,000 feet of elevation, is to deliver 6,000 CFM at a static pressure of 1.5". Use the unit blower tables to select the blower speed and the BHP requirement.

Solution: As in the example above, no temperature information is given so 70°F is assumed.

The 1.5" static pressure given is at an elevation of 5,000 ft. The first step is to convert this static pressure to equivalent sea level conditions.

Sea level static pressure = 1.5 / .832 = 1.80"

Enter the blower table at 6000 sCFM and static pressure of 1.8". The rpm listed will be the same rpm needed at 5,000 ft.

Suppose that the corresponding BHP listed in the table is 3.2. This value must be corrected for elevation.

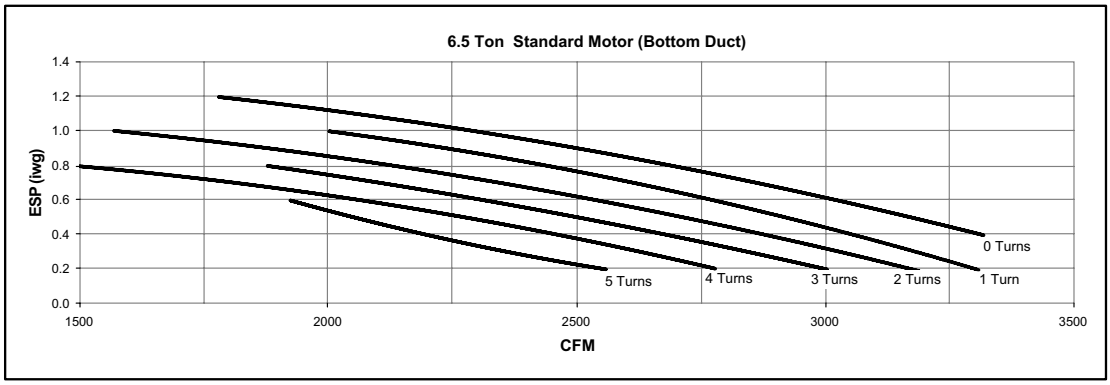
BHP at 5,000 ft. = 3.2 x .832 = 2.66

Table 16: ZH Bottom Duct Blower Performance

ZH078 (6.5 Ton) Standard Motor Bottom Duct Blower Performance

6.5 Ton STANDARD MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]																								
ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	3310	1079	1590	1.71	3190	1035	1410	1.51	3005	991	1230	1.32	2780	945	1070	1.15	2560	897	940	1.01
0.4	3320	1126	1650	1.77	3050	1082	1440	1.54	2850	1038	1290	1.38	2680	992	1100	1.18	2480	946	970	1.04	2200	899	840	0.90
0.6	3020	1129	1530	1.64	2780	1086	1320	1.42	2550	1040	1150	1.23	2320	996	980	1.05	2055	948	840	0.90	1925	902	720	0.77
0.8	2700	1132	1380	1.48	2450	1088	1180	1.27	2160	1043	1010	1.08	1879	998	840	0.90	1500	952	700	0.75	-	-	-	-
1.0	2300	1136	1230	1.32	2003	1091	1010	1.08	1570	1047	820	0.88	-	-	-	-	-	-	-	-	-	-	-	-
1.2	1781	1120	1010	1.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

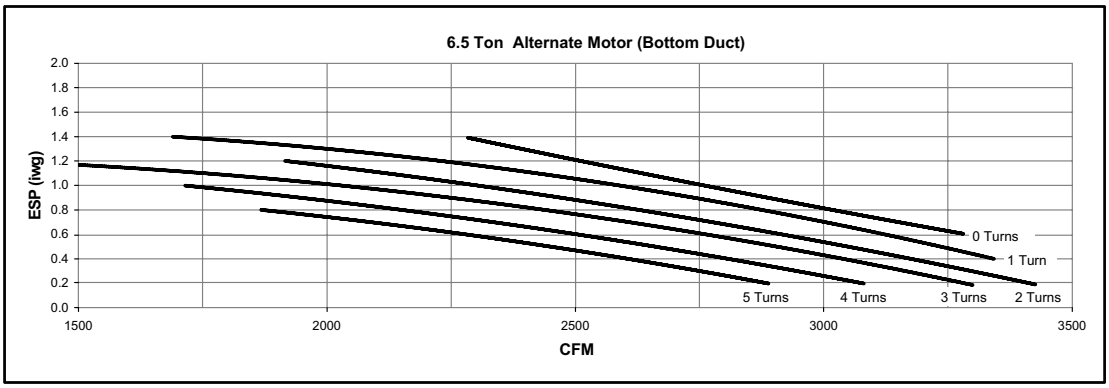
1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts



ZH078 (6.5 Ton) Alternate Motor Bottom Duct Blower Performance

6.5 Ton ALTERNATE MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]																								
ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	3426	1156	1940	2.08	3300	1108	1700	1.82	3081	1057	1500	1.61	2889	1004	1300	1.39
0.4	-	-	-	-	3343	1207	2040	2.19	3155	1160	1780	1.91	3014	1111	1590	1.71	2800	1059	1380	1.48	2600	1007	1170	1.26
0.6	3281	1259	2140	2.30	3123	1212	1910	2.05	2912	1164	1650	1.77	2757	1114	1460	1.57	2514	1062	1240	1.33	2287	1008	1050	1.13
0.8	3031	1262	1970	2.11	2875	1215	1760	1.89	2651	1167	1500	1.61	2449	1116	1320	1.42	2148	1065	1090	1.17	1868	1012	900	0.97
1.0	2765	1268	1810	1.94	2595	1220	1630	1.75	2300	1171	1360	1.46	2051	1120	1170	1.26	1715	1069	950	1.02	-	-	-	-
1.2	2493	1273	1700	1.82	2228	1225	1420	1.52	1916	1176	1160	1.24	1323	1126	880	0.94	-	-	-	-	-	-	-	-

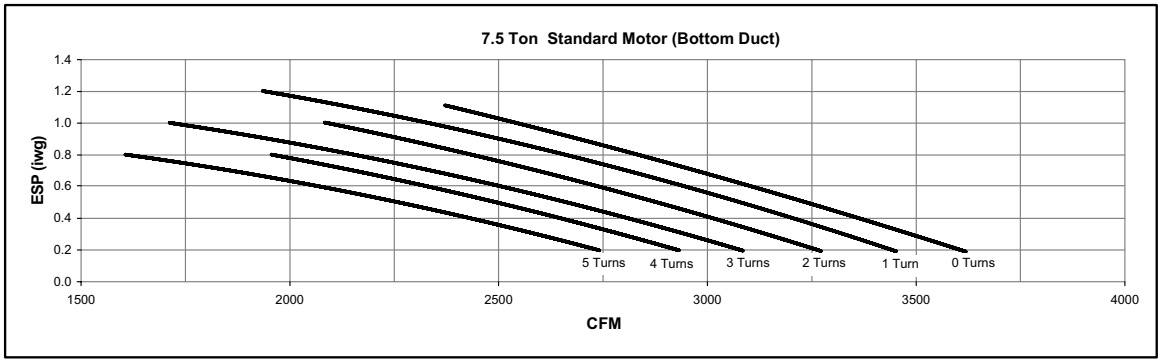
1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts



ZH090 (7.5 Ton) Standard Motor Bottom Duct Blower Performance

7.5 Ton STANDARD MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]																								
ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	3619	1203	2148	2.30	3452	1156	1913	2.05	3272	1110	1696	1.82	3085	1063	1503	1.61	2932	1013	1299	1.39	2742	963	1123	1.20
0.4	3343	1204	1988	2.13	3189	1159	1781	1.91	2995	1113	1547	1.66	2798	1065	1360	1.46	2640	1014	1190	1.28	2421	965	1024	1.10
0.6	3100	1205	1857	1.99	2944	1162	1676	1.80	2746	1116	1440	1.54	2512	1068	1246	1.34	2340	1017	1067	1.14	2084	967	918	0.98
0.8	2846	1205	1712	1.84	2675	1166	1534	1.65	2448	1118	1326	1.42	2162	1071	1098	1.18	1956	1020	934	1.00	1606	969	781	0.84
1.0	2559	1207	1574	1.69	2335	1169	1364	1.46	2084	1119	1174	1.26	1712	1074	941	1.01	-	-	-	-	-	-	-	-
1.2	2219	1209	1435	1.54	1935	1174	1039	1.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

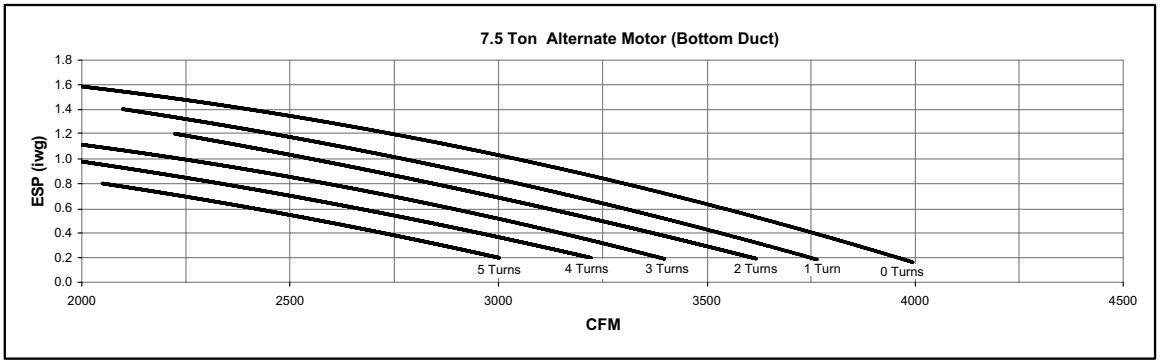
1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts



ZH090 (7.5 Ton) Alternate Motor Bottom Duct Blower Performance

7.5 Ton ALTERNATE MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]																								
ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	3995	1299	2790	2.99	3765	1249	2420	2.60	3619	1198	2147	2.30	3399	1144	1849	1.98	3223	1092	1630	1.75	3002	1038	1421	1.52
0.4	3718	1303	2580	2.77	3508	1252	2290	2.46	3353	1201	2010	2.16	3131	1147	1715	1.84	2945	1094	1525	1.64	2715	1039	1328	1.42
0.6	3506	1305	2440	2.62	3288	1255	2117	2.27	3107	1203	1862	2.00	2876	1149	1603	1.72	2666	1096	1368	1.47	2418	1042	1206	1.29
0.8	3290	1308	2290	2.46	3053	1258	1982	2.13	2858	1206	1712	1.84	2594	1152	1487	1.60	2334	1099	1248	1.34	2049	1044	1037	1.11
1.0	3065	1312	2167	2.32	2795	1261	1844	1.98	2558	1209	1602	1.72	2259	1155	1318	1.41	1954	1101	1095	1.17	-	-	-	-
1.2	2799	1315	1977	2.12	2458	1264	1675	1.80	2223	1212	1408	1.51	1780	1159	1084	1.16	-	-	-	-	-	-	-	-
1.4	2401	1320	1775	1.90	2098	1269	1487	1.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.6	1940	1325	1514	1.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

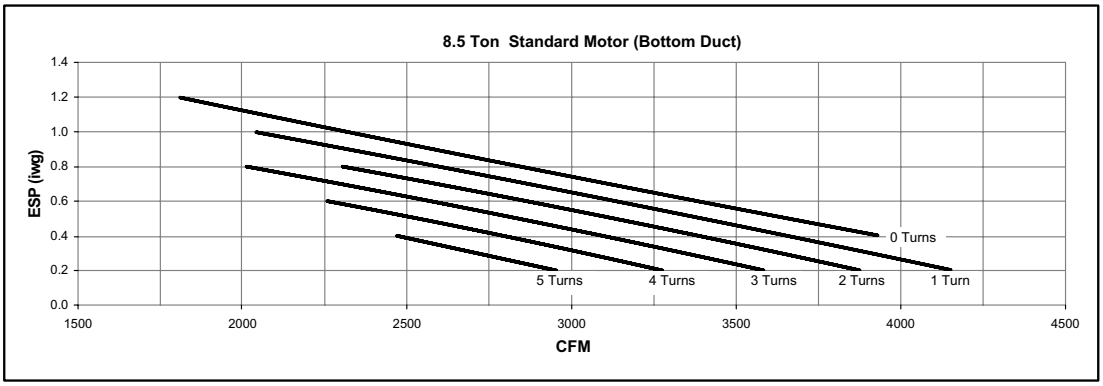


ZH102 (8.5 Ton) Standard Motor Bottom Duct Blower Performance

8.5 Ton STANDARD MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	4152	889	1682	1.80	3875	851	1506	1.62	3583	813	1339	1.44	3276	774	1179	1.26	2953	735	1027	1.10
0.4	3929	928	1747	1.87	3668	890	1563	1.68	3391	852	1387	1.49	3099	814	1219	1.31	2792	775	1060	1.14	2469	736	908	0.97
0.6	3395	930	1595	1.71	3133	892	1411	1.51	2857	854	1235	1.33	2564	816	1068	1.15	2257	777	908	0.97	-	-	-	-
0.8	2842	933	1423	1.53	2580	895	1239	1.33	2304	857	1063	1.14	2012	819	895	0.96	-	-	-	-	-	-	-	-
1.0	2303	936	1242	1.33	2041	898	1058	1.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2	1810	939	1065	1.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

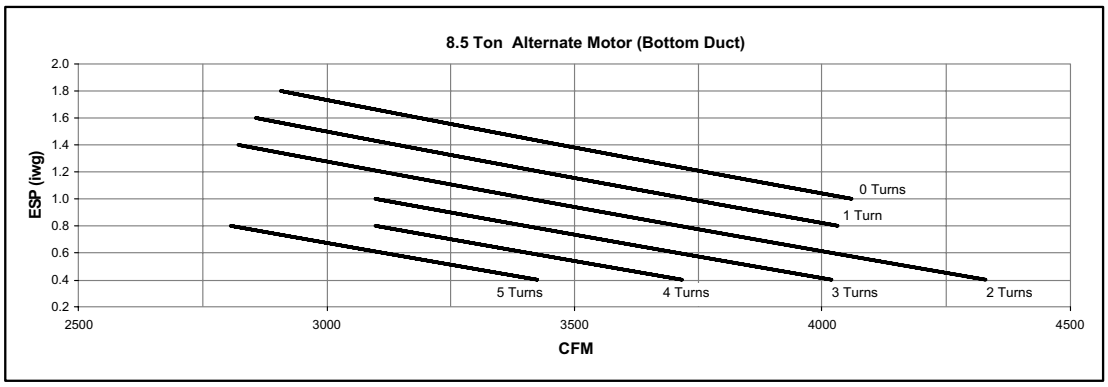


ZH102 (8.5 Ton) Alternate Motor Bottom Duct Blower Performance

8.5 Ton ALTERNATE MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.4	-	-	-	-	-	-	-	-	4330	1005	3172	3.40	4019	964	2788	2.99	3717	921	2417	2.59	3425	877	2060	2.21
0.6	-	-	-	-	-	-	-	-	4018	1008	3000	3.22	3707	967	2616	2.81	3405	924	2245	2.41	3113	880	1887	2.02
0.8	-	-	-	-	4031	1051	3224	3.46	3711	1012	2827	3.03	3400	971	2442	2.62	3098	928	2071	2.22	2806	884	1714	1.84
1.0	4059	1093	3457	3.71	3729	1055	3046	3.27	3409	1016	2648	2.84	3098	975	2263	2.43	-	-	-	-	-	-	-	-
1.2	3763	1098	3269	3.51	3433	1061	2858	3.07	3112	1022	2460	2.64	-	-	-	-	-	-	-	-	-	-	-	-
1.4	3472	1104	3068	3.29	3142	1067	2656	2.85	2822	1028	2259	2.42	-	-	-	-	-	-	-	-	-	-	-	-
1.6	3187	1112	2850	3.06	2857	1074	2439	2.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8	2907	1120	2611	2.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

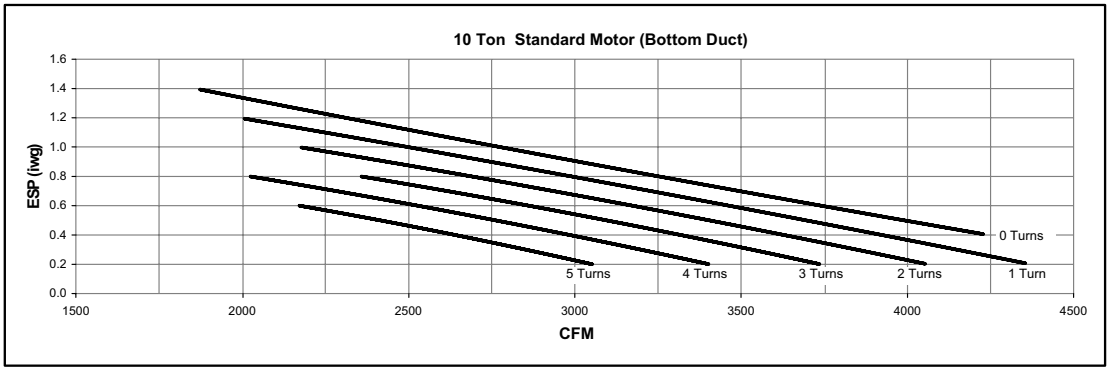


ZH120 (10 Ton) Standard Motor Bottom Duct Blower Performance

10 Ton STANDARD MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	4355	938	1969	2.11	4054	899	1748	1.88	3736	857	1535	1.65	3402	814	1330	1.43	3052	769	1132	1.21
0.4	4229	978	2067	2.22	3943	940	1838	1.97	3642	901	1618	1.74	3324	859	1405	1.51	2990	816	1200	1.29	2640	771	1002	1.08
0.6	3760	980	1908	2.05	3475	943	1680	1.80	3173	903	1459	1.57	2856	862	1247	1.34	2522	818	1041	1.12	2172	773	844	0.91
0.8	3263	983	1732	1.86	2978	946	1504	1.61	2676	906	1284	1.38	2359	865	1071	1.15	2025	822	865	0.93	-	-	-	-
1.0	2765	987	1550	1.66	2480	949	1321	1.42	2178	910	1101	1.18	-	-	-	-	-	-	-	-	-	-	-	-
1.2	2292	990	1370	1.47	2007	953	1142	1.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.4	1873	993	1206	1.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

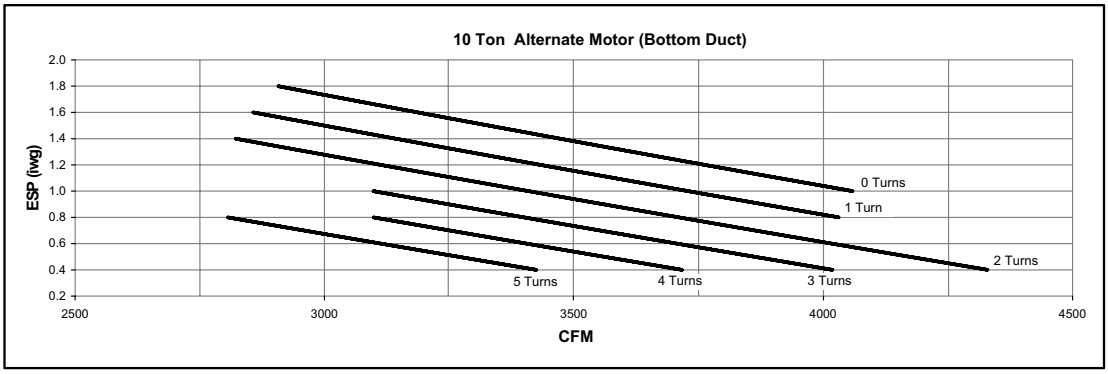


ZH120 (10 Ton) Alternate Motor Bottom Duct Blower Performance

10 Ton ALTERNATE MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.4	-	-	-	-	-	-	-	-	4330	1005	3172	3.40	4019	964	2788	2.99	3717	921	2417	2.59	3425	877	2060	2.21
0.6	-	-	-	-	-	-	-	-	4018	1008	3000	3.22	3707	967	2616	2.81	3405	924	2245	2.41	3113	880	1887	2.02
0.8	-	-	-	-	4031	1051	3224	3.46	3711	1012	2827	3.03	3400	971	2442	2.62	3098	928	2071	2.22	2806	884	1714	1.84
1.0	4059	1093	3457	3.71	3729	1055	3046	3.27	3409	1016	2648	2.84	3098	975	2263	2.43	-	-	-	-	-	-	-	-
1.2	3763	1098	3269	3.51	3433	1061	2858	3.07	3112	1022	2460	2.64	-	-	-	-	-	-	-	-	-	-	-	-
1.4	3472	1104	3068	3.29	3142	1067	2656	2.85	2822	1028	2259	2.42	-	-	-	-	-	-	-	-	-	-	-	-
1.6	3187	1112	2850	3.06	2857	1074	2439	2.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8	2907	1120	2611	2.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

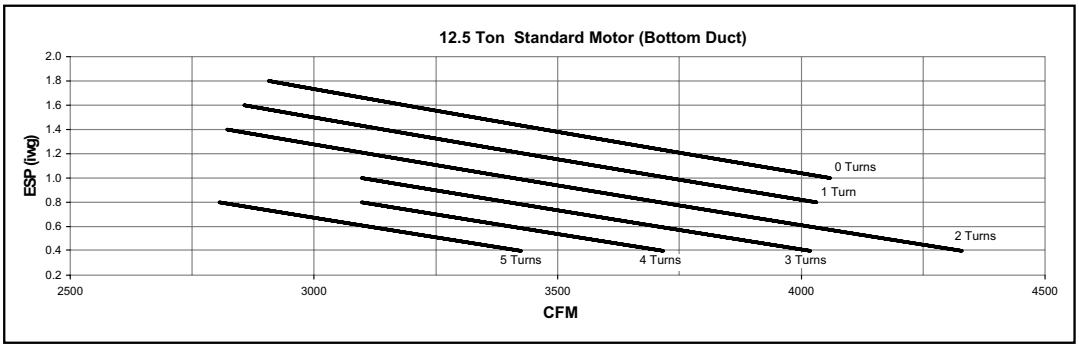


ZH150 (12.5 Ton) Standard Motor Bottom Duct Blower Performance

12.5 Ton STANDARD MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.4	-	-	-	-	-	-	-	-	4330	1005	3172	3.40	4019	964	2788	2.99	3717	921	2417	2.59	3425	877	2060	2.21
0.6	-	-	-	-	-	-	-	-	4018	1008	3000	3.22	3707	967	2616	2.81	3405	924	2245	2.41	3113	880	1887	2.02
0.8	-	-	-	-	4031	1051	3224	3.46	3711	1012	2827	3.03	3400	971	2442	2.62	3098	928	2071	2.22	2806	884	1714	1.84
1.0	4059	1093	3457	3.71	3729	1055	3046	3.27	3409	1016	2648	2.84	3098	975	2263	2.43	-	-	-	-	-	-	-	-
1.2	3763	1098	3269	3.51	3433	1061	2858	3.07	3112	1022	2460	2.64	-	-	-	-	-	-	-	-	-	-	-	-
1.4	3472	1104	3068	3.29	3142	1067	2656	2.85	2822	1028	2259	2.42	-	-	-	-	-	-	-	-	-	-	-	-
1.6	3187	1112	2850	3.06	2857	1074	2439	2.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8	2907	1120	2611	2.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts



ZH150 (12.5 Ton) Alternate Motor Bottom Duct Blower Performance

12.5 Ton ALTERNATE MOTOR BOTTOM DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.4	-	-	-	-	5864	1204	5252	5.63	5489	1163	4675	5.02	5143	1124	4168	4.47	4827	1085	3730	4.00	4541	1047	3361	3.61
0.6	-	-	-	-	5546	1206	5022	5.39	5171	1165	4446	4.77	4825	1125	3939	4.23	4510	1087	3501	3.76	4223	1049	3132	3.36
0.8	-	-	-	-	5242	1208	4808	5.16	4866	1168	4232	4.54	4521	1128	3724	4.00	4205	1089	3287	3.53	3919	1051	2918	3.13
1.0	5351	1254	5250	5.63	4946	1212	4604	4.94	4571	1172	4027	4.32	4225	1132	3520	3.78	3909	1093	3082	3.31	3623	1055	2713	2.91
1.2	5062	1258	5049	5.42	4657	1216	4403	4.72	4282	1176	3827	4.11	3936	1136	3319	3.56	3620	1097	2881	3.09	3334	1059	2513	2.70
1.4	4775	1263	4847	5.20	4370	1221	4201	4.51	3995	1181	3625	3.89	3650	1141	3118	3.34	3334	1102	2680	2.87	-	-	-	-
1.6	4488	1268	4639	4.98	4083	1227	3993	4.28	3708	1186	3417	3.67	3362	1147	2909	3.12	-	-	-	-	-	-	-	-
1.8	4197	1274	4419	4.74	3792	1233	3773	4.05	3416	1192	3196	3.43	-	-	-	-	-	-	-	-	-	-	-	-
2.0	3898	1280	4181	4.49	3493	1239	3536	3.79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.2	3588	1286	3921	4.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

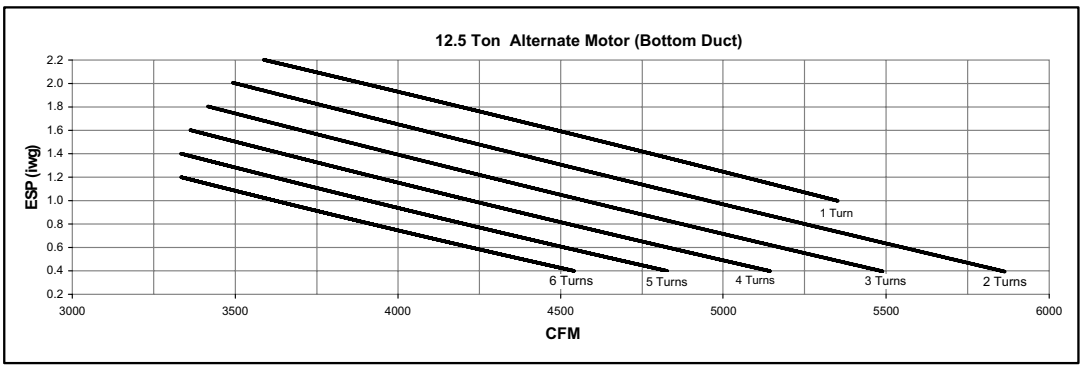
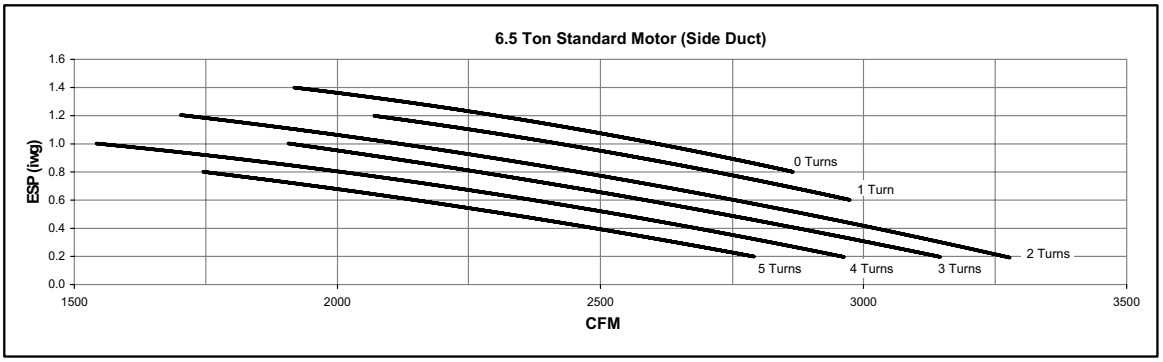


Table 17: ZH Side Duct Blower Performance

ZH078 (6.5 Ton) Standard Motor Side Duct Blower Performance

6.5 Ton STANDARD MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]																								
ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	3278	1021	1540	1.65	3146	980	1370	1.47	2963	936	1200	1.29	2792	892	1040	1.12
0.4	-	-	-	-	-	-	-	-	3007	1025	1430	1.53	2865	982	1280	1.37	2673	939	1100	1.18	2483	893	940	1.01
0.6	-	-	-	-	2974	1071	1530	1.64	2749	1029	1320	1.42	2585	986	1170	1.26	2371	941	980	1.05	2154	894	850	0.91
0.8	2866	1117	1600	1.72	2724	1075	1420	1.52	2465	1032	1220	1.31	2278	989	1050	1.13	2020	944	890	0.95	1745	896	750	0.80
1.0	2611	1122	1470	1.58	2417	1079	1300	1.39	2133	1036	1100	1.18	1907	992	940	1.01	1542	947	760	0.82	-	-	-	-
1.2	2300	1126	1340	1.44	2070	1083	1160	1.24	1702	1040	950	1.02	-	-	-	-	-	-	-	-	-	-	-	-
1.4	1918	1131	1180	1.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

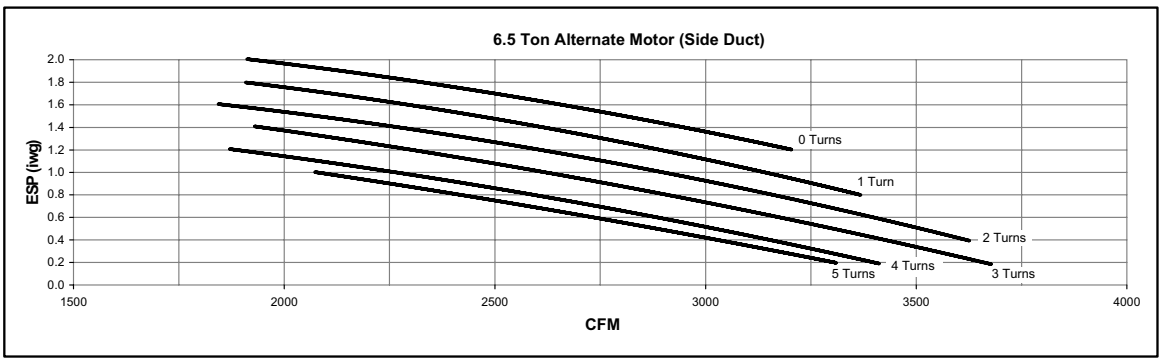
1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts



ZH078 (6.5 Ton) Alternate Motor Side Duct Blower Performance

6.5 Ton ALTERNATE MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]																								
ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	-	-	-	-	3678	1102	1900	2.04	3412	1044	1600	1.72	3310	1001	1500	1.61
0.4	-	-	-	-	-	-	-	-	3626	1152	2100	2.25	3406	1137	1830	1.96	3134	1046	1510	1.62	3020	1003	1390	1.49
0.6	-	-	-	-	-	-	-	-	3397	1156	1970	2.11	3160	1107	1680	1.80	2879	1048	1380	1.48	2734	1005	1260	1.35
0.8	-	-	-	-	3368	1206	2130	2.29	3148	1159	1830	1.96	2909	1110	1560	1.67	2596	1050	1270	1.36	2428	1008	1150	1.23
1.0	-	-	-	-	3139	1211	1990	2.13	2891	1162	1690	1.81	2642	1113	1450	1.56	2288	1053	1140	1.22	2073	1010	1030	1.10
1.2	3204	1259	2190	2.35	2892	1213	1840	1.97	2619	1167	1560	1.67	2316	1116	1320	1.42	1871	1056	1020	1.09	-	-	-	-
1.4	2966	1264	2070	2.22	2621	1217	1700	1.82	2289	1170	1420	1.52	1930	1120	1160	1.24	-	-	-	-	-	-	-	-
1.6	2594	1270	1890	2.03	2286	1221	1550	1.66	1844	1175	1240	1.33	-	-	-	-	-	-	-	-	-	-	-	-
1.8	2391	1273	1740	1.87	1909	1226	1370	1.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	1912	1279	1510	1.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

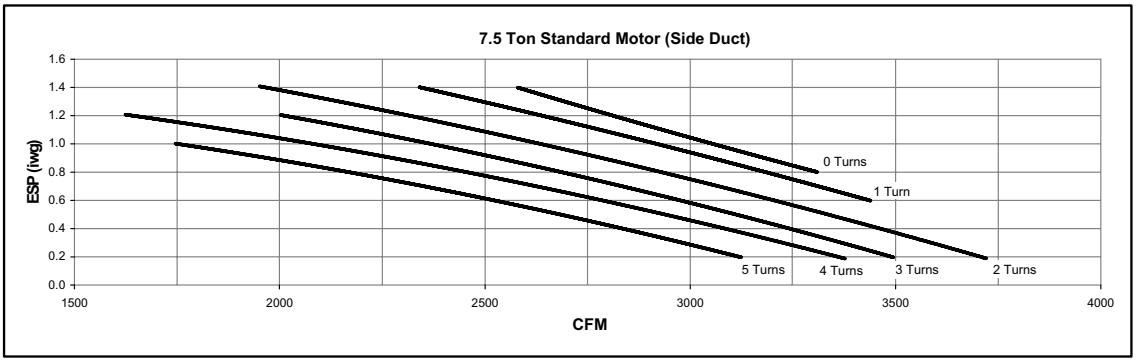


ZH090 (7.5 Ton) Standard Motor Side Duct Blower Performance

7.5 Ton STANDARD MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	3721	1108	1951	2.09	3495	1053	1684	1.81	3377	1006	1520	1.63	3124	957	1309	1.40
0.4	-	-	-	-	-	-	-	-	3446	1104	1831	1.96	3239	1055	1408	1.51	3058	1008	1388	1.49	2825	959	1182	1.27
0.6	-	-	-	-	3439	1152	1996	2.14	3198	1106	1697	1.82	2964	1057	1456	1.56	2772	1010	1268	1.36	2523	960	1090	1.17
0.8	3309	1202	2058	2.21	3178	1156	1847	1.98	2922	1109	1591	1.71	2688	1060	1336	1.43	2469	1012	1177	1.26	2177	963	975	1.05
1.0	3058	1206	1899	2.04	2918	1159	1714	1.84	2649	1111	1453	1.56	2385	1063	1241	1.33	2108	1015	1035	1.11	1746	965	851	0.91
1.2	2809	1209	1793	1.92	2645	1162	1595	1.71	2333	1115	1325	1.42	2002	1066	1114	1.19	1624	1017	886	0.95	-	-	-	-
1.4	2580	1212	1701	1.82	2340	1165	1455	1.56	1951	1118	1176	1.26	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

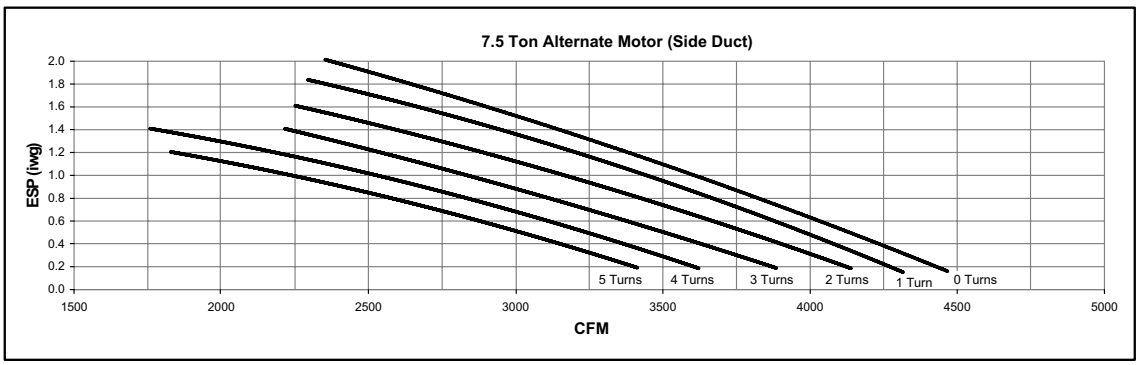


ZH090 (7.5 Ton) Alternate Motor Side Duct Blower Performance

7.5 Ton ALTERNATE MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	4467	1295	3131	3.36	4316	1246	2800	3.00	4139	1195	2476	2.66	3886	1146	2178	2.34	3622	1092	1894	2.03	3413	1037	1644	1.76
0.4	4216	1299	3018	3.24	4058	1248	2708	2.91	3882	1199	2391	2.56	3612	1147	2048	2.20	3351	1095	1775	1.90	3139	1039	1550	1.66
0.6	4001	1301	2861	3.07	3825	1252	2534	2.72	3664	1201	2290	2.46	3369	1149	1915	2.05	3100	1097	1643	1.76	2869	1041	1408	1.51
0.8	3804	1304	2729	2.93	3652	1254	2426	2.60	3436	1204	2097	2.25	3118	1151	1816	1.95	2827	1099	1552	1.67	2583	1042	1307	1.40
1.0	3603	1308	2598	2.79	3442	1256	2306	2.47	3153	1207	2000	2.15	2840	1153	1644	1.76	2539	1100	1398	1.50	2259	1045	1173	1.26
1.2	3370	1310	2435	2.61	3225	1259	2173	2.33	2898	1209	1858	1.99	2560	1155	1554	1.67	2215	1103	1294	1.39	1828	1047	1027	1.10
1.4	3185	1312	2327	2.50	2970	1262	2049	2.20	2617	1212	1719	1.84	2216	1158	1417	1.52	1758	1105	1116	1.20	-	-	-	-
1.6	2928	1315	2173	2.33	2742	1266	1944	2.09	2251	1214	1555	1.67	-	-	-	-	-	-	-	-	-	-	-	-
1.8	2678	1319	2055	2.20	2294	1268	1687	1.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	2326	1354	1844	1.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

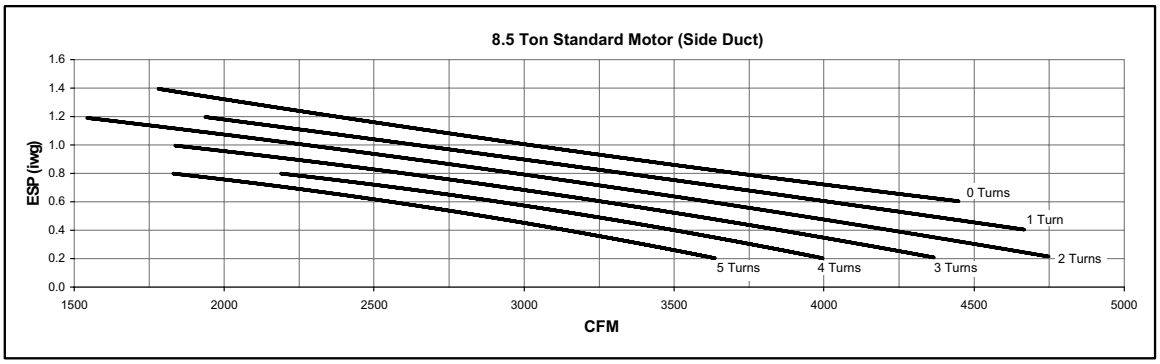


ZH102 (8.5 Ton) Standard Motor Side Duct Blower Performance

8.5 Ton STANDARD MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	4748	842	1941	2.08	4366	806	1702	1.83	3995	769	1479	1.59	3636	731	1273	1.37
0.4	-	-	-	-	4667	879	2055	2.20	4273	844	1800	1.93	3891	807	1561	1.67	3520	770	1338	1.44	3160	733	1132	1.21
0.6	4448	918	2117	2.27	4043	882	1845	1.98	3649	847	1590	1.71	3267	810	1351	1.45	2896	773	1129	1.21	2537	736	922	0.99
0.8	3742	922	1862	2.00	3336	887	1591	1.71	2942	851	1336	1.43	2560	814	1097	1.18	2189	778	874	0.94	1830	740	668	0.72
1.0	3018	927	1588	1.70	2612	891	1316	1.41	2219	856	1061	1.14	1836	819	822	0.88	-	-	-	-	-	-	-	-
1.2	2342	932	1316	1.41	1937	897	1045	1.12	1543	861	790	0.85	-	-	-	-	-	-	-	-	-	-	-	-
1.4	1780	937	1073	1.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

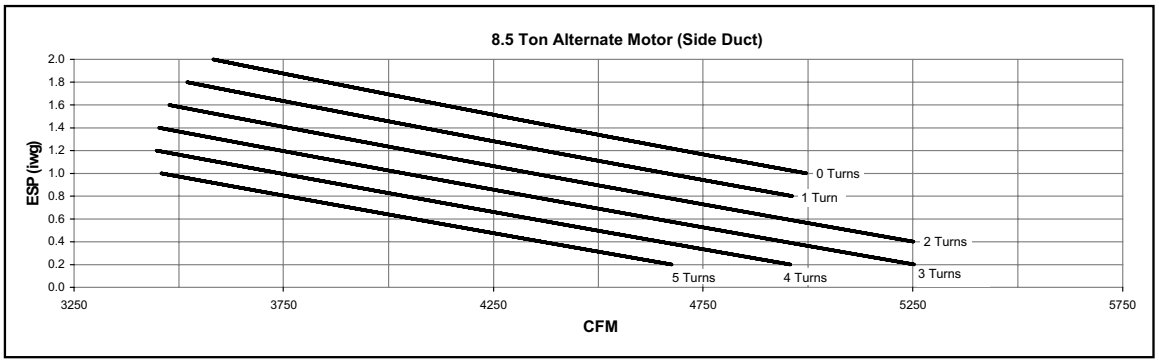


ZH102 (8.5 Ton) Alternate Motor Side Duct Blower Performance

8.5 Ton ALTERNATE MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	-	-	-	-	5253	961	2963	3.18	4958	918	2592	2.78	4675	874	2234	2.40
0.4	-	-	-	-	-	-	-	-	5252	1005	3172	3.40	4944	964	2788	2.99	4649	921	2417	2.59	4366	877	2060	2.21
0.6	-	-	-	-	-	-	-	-	4945	1008	3000	3.22	4638	967	2616	2.81	4343	924	2245	2.41	4060	880	1887	2.02
0.8	-	-	-	-	4962	1051	3224	3.46	4642	1012	2827	3.03	4335	971	2442	2.62	4040	928	2071	2.22	3757	884	1714	1.84
1.0	4996	1093	3457	3.71	4664	1055	3046	3.27	4344	1016	2648	2.84	4036	975	2263	2.43	3741	933	1892	2.03	3458	888	1535	1.65
1.2	4701	1098	3269	3.51	4369	1061	2858	3.07	4049	1022	2460	2.64	3742	981	2075	2.23	3447	938	1704	1.83	-	-	-	-
1.4	4412	1104	3068	3.29	4080	1067	2656	2.85	3760	1028	2259	2.42	3453	987	1874	2.01	-	-	-	-	-	-	-	-
1.6	4129	1112	2850	3.06	3797	1074	2439	2.62	3477	1035	2041	2.19	-	-	-	-	-	-	-	-	-	-	-	-
1.8	3852	1120	2611	2.80	3520	1083	2200	2.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	3582	1130	2348	2.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

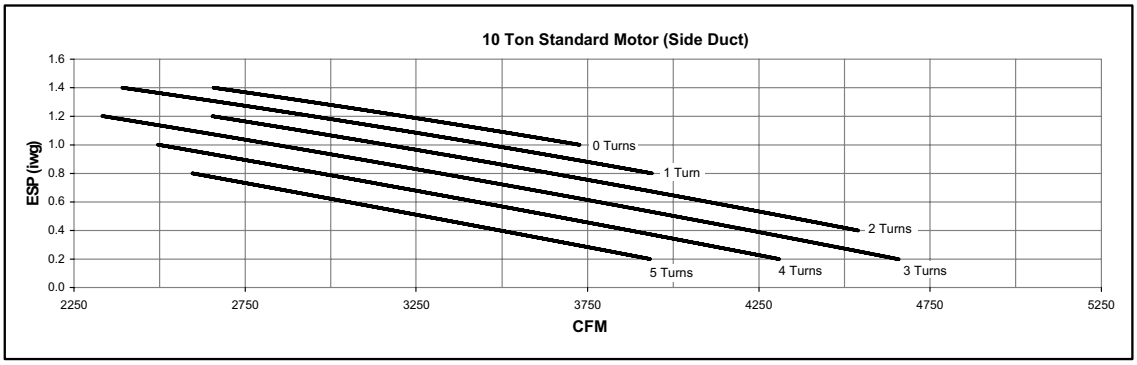


ZH120 (10 Ton) Standard Motor Side Duct Blower Performance

10 Ton STANDARD MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	-	-	-	-	4659	853	1999	2.14	4309	818	1723	1.85	3932	785	1454	1.56
0.4	-	-	-	-	-	-	-	-	4540	889	2131	2.29	4218	853	1847	1.98	3869	819	1570	1.68	3492	785	1301	1.40
0.6	-	-	-	-	-	-	-	-	4098	892	1929	2.07	3777	856	1645	1.76	3427	821	1368	1.47	3050	788	1099	1.18
0.8	-	-	-	-	3938	933	1981	2.13	3644	896	1689	1.81	3322	860	1405	1.51	2973	825	1129	1.21	2596	792	860	0.92
1.0	3727	978	2015	2.16	3460	939	1717	1.84	3166	902	1425	1.53	2844	866	1141	1.22	2495	831	865	0.93	-	-	-	-
1.2	3215	986	1739	1.87	2948	947	1440	1.55	2654	910	1149	1.23	2332	874	865	0.93	-	-	-	-	-	-	-	-
1.4	2657	996	1463	1.57	2391	958	1164	1.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

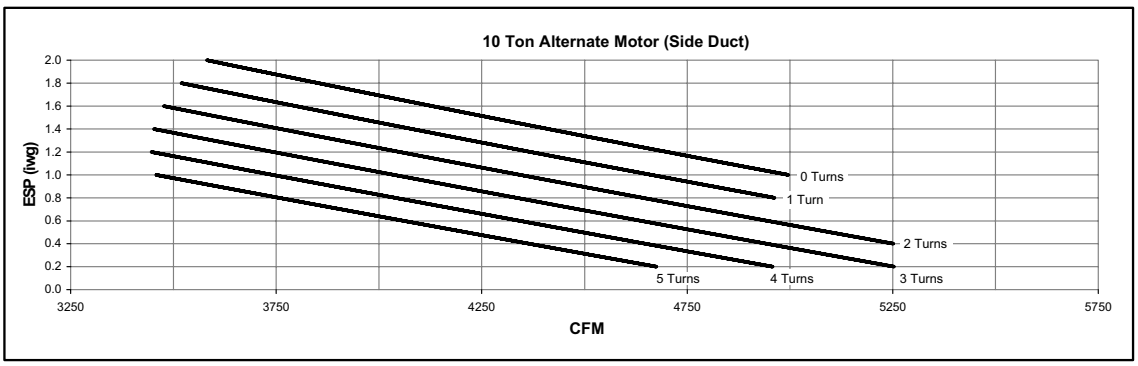


ZH120 (10 Ton) Alternate Motor Side Duct Blower Performance

10 Ton ALTERNATE MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	-	-	-	-	5253	961	2963	3.18	4958	918	2592	2.78	4675	874	2234	2.40
0.4	-	-	-	-	-	-	-	-	5252	1005	3172	3.40	4944	964	2788	2.99	4649	921	2417	2.59	4366	877	2060	2.21
0.6	-	-	-	-	-	-	-	-	4945	1008	3000	3.22	4638	967	2616	2.81	4343	924	2245	2.41	4060	880	1887	2.02
0.8	-	-	-	-	4962	1051	3224	3.46	4642	1012	2827	3.03	4335	971	2442	2.62	4040	928	2071	2.22	3757	884	1714	1.84
1.0	4996	1093	3457	3.71	4664	1055	3046	3.27	4344	1016	2648	2.84	4036	975	2263	2.43	3741	933	1892	2.03	3458	888	1535	1.65
1.2	4701	1098	3269	3.51	4369	1061	2858	3.07	4049	1022	2460	2.64	3742	981	2075	2.23	3447	938	1704	1.83	-	-	-	-
1.4	4412	1104	3068	3.29	4080	1067	2656	2.85	3760	1028	2259	2.42	3453	987	1874	2.01	-	-	-	-	-	-	-	-
1.6	4129	1112	2850	3.06	3797	1074	2439	2.62	3477	1035	2041	2.19	-	-	-	-	-	-	-	-	-	-	-	-
1.8	3852	1120	2611	2.80	3520	1083	2200	2.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	3582	1130	2348	2.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

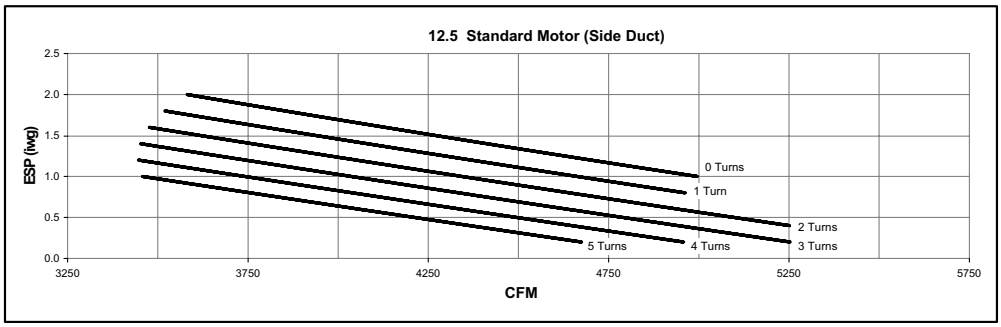


ZH150 (12.5 Ton) Standard Motor Side Duct Blower Performance

12.5 Ton STANDARD MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.2	-	-	-	-	-	-	-	-	-	-	-	-	5253	961	2963	3.18	4958	918	2592	2.78	4675	874	2234	2.40
0.4	-	-	-	-	-	-	-	-	5252	1005	3172	3.40	4944	964	2788	2.99	4649	921	2417	2.59	4366	877	2060	2.21
0.6	-	-	-	-	-	-	-	-	4945	1008	3000	3.22	4638	967	2616	2.81	4343	924	2245	2.41	4060	880	1887	2.02
0.8	-	-	-	-	4962	1051	3224	3.46	4642	1012	2827	3.03	4335	971	2442	2.62	4040	928	2071	2.22	3757	884	1714	1.84
1.0	4996	1093	3457	3.71	4664	1055	3046	3.27	4344	1016	2648	2.84	4036	975	2263	2.43	3741	933	1892	2.03	3458	888	1535	1.65
1.2	4701	1098	3269	3.51	4369	1061	2858	3.07	4049	1022	2460	2.64	3742	981	2075	2.23	3447	938	1704	1.83	-	-	-	-
1.4	4412	1104	3068	3.29	4080	1067	2656	2.85	3760	1028	2259	2.42	3453	987	1874	2.01	-	-	-	-	-	-	-	-
1.6	4129	1112	2850	3.06	3797	1074	2439	2.62	3477	1035	2041	2.19	-	-	-	-	-	-	-	-	-	-	-	-
1.8	3852	1120	2611	2.80	3520	1083	2200	2.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0	3582	1130	2348	2.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts

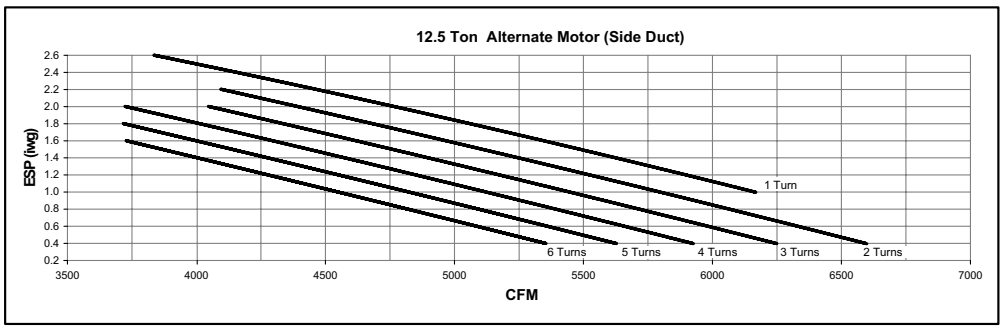


ZH150 (12.5 Ton) Alternate Motor Side Duct Blower Performance

12.5 Ton ALTERNATE MOTOR SIDE DUCT BLOWER PERFORMANCE[1, 2]

ESP[3]	TURNS OPEN[4]																							
	0 Turns				1 Turns				2 Turns				3 Turns				4 Turns				5 Turns			
	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP	CFM	RPM	W[5]	BHP
0.4	-	-	-	-	6598	1204	5252	5.63	6249	1163	4675	5.02	5926	1124	4168	4.47	5628	1085	3730	4.00	5354	1047	3361	3.61
0.6	-	-	-	-	6330	1206	5022	5.39	5981	1165	4446	4.77	5658	1125	3939	4.23	5359	1087	3501	3.76	5086	1049	3132	3.36
0.8	-	-	-	-	6062	1208	4808	5.16	5713	1168	4232	4.54	5390	1128	3724	4.00	5092	1089	3287	3.53	4819	1051	2918	3.13
1.0	6168	1254	5250	5.63	5794	1212	4604	4.94	5445	1172	4027	4.32	5122	1132	3520	3.78	4823	1093	3082	3.31	4550	1055	2713	2.91
1.2	5897	1258	5049	5.42	5524	1216	4403	4.72	5175	1176	3827	4.11	4851	1136	3319	3.56	4553	1097	2881	3.09	4280	1059	2513	2.70
1.4	5624	1263	4847	5.20	5250	1221	4201	4.51	4901	1181	3625	3.89	4578	1141	3118	3.34	4279	1102	2680	2.87	4006	1064	2311	2.48
1.6	5345	1268	4639	4.98	4971	1227	3993	4.28	4623	1186	3417	3.67	4299	1147	2909	3.12	4001	1108	2471	2.65	3728	1070	2103	2.26
1.8	5061	1274	4419	4.74	4687	1233	3773	4.05	4338	1192	3196	3.43	4015	1152	2689	2.88	3717	1114	2251	2.42	-	-	-	-
2.0	4769	1280	4181	4.49	4395	1239	3536	3.79	4047	1198	2959	3.17	3723	1158	2452	2.63	-	-	-	-	-	-	-	-
2.2	4469	1286	3921	4.21	4095	1245	3276	3.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.4	4158	1292	3633	3.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.6	3836	1298	3312	3.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Blower performance for gas heat includes maximum number of heat tubes available for each tonnage.
2. Blower performance includes two-inch throwaway filters.
3. ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.
4. "Turns Open" refers to the setting of the variable pitch motor sheave, where "0 Turns Open" is fully closed.
5. W = Watts



NOTES FOR TABLE 16 AND 17:

- Blower performance includes dry coil and two-inch filters.
- Blower performance for gas heat includes the maximum number of heat tubes available for each tonnage.
- ESP (External Static Pressure) given is that available for the supply and return air duct system. All internal resistances have been deducted from the total static pressure of the blower.

Table 18: Indoor Blower Specifications

Size (Tons)	Model	Motor					Motor Sheave			Blower Sheave			Belt
		HP	RPM	Eff.	SF	Frame	Datum Dia. (in.)	Bore (in.)	Model	Datum Dia. (in.)	Bore (in.)	Model	
078 (6.5)	ZH	1-1/2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A49
		2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	6.2	1	AK66	A49
090 (7.5)	ZH	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	6.5	1	AK69	A49
		3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	6.0	1	AK64	A49
102 (8.5)	ZH	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.5	1	AK89	A56
		3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
120 (10)	ZH	2	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	8.0	1	AK84	A56
		3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
150 (12.5)	ZH	3	1725	0.8	1.15	56	3.4 - 4.4	7/8	1VM50	7.0	1	AK74	A54
		5	1725	0.87	1.15	184T	4.3 - 5.3	1-1/8	1VP56	6.7	1	BK77	BX55

Table 19: Power Exhaust Specifications

Model	Voltage	Motor			Motor			Fuse Size	CFM @ 0.1 ESP
		HP	RPM[1]	QTY	LRA	FLA	MCA		
2PE04703225	208/230-1-60	3/4	1075	1	7.8	5	6.3	10	3800
2PE04703246	460-1-60	3/4	1075	1	3.4	2.2	2.8	5	3800
2PE04703258	575-1-60	3/4	1050	1	2.9	1.5	1.9	4	3800

1. Motors are multi-tapped and factory wired for high speed.

Air Balance

Start the supply air blower motor. Adjust the resistances in both the supply and the return air duct systems to balance the air distribution throughout the conditioned space. The job specifications may require that this balancing be done by someone other than the equipment installer.

Checking Air Quantity

Method One

1. Remove the dot plugs from the duct panel (for location of the dot plugs see Figures 12 and 13).
2. Insert eight-inches of 1/4 inch metal tubing into the airflow on both sides of the indoor coil.

NOTE: The tubes must be inserted and held in a position perpendicular to the air flow so that velocity pressure will not affect the static pressure readings.

3. Use an Inclined Manometer or Magnehelic to determine the pressure drop across a dry evaporator coil. Since the moisture on an evaporator coil can vary greatly, measuring the pressure drop across a wet coil under field conditions could be inaccurate. To assure a dry coil, the compressors should be de-activated while the test is being run.

NOTE: De-energize the compressors before taking any test measurements to assure a dry evaporator coil.

4. The CFM through the unit can be determined from the pressure drop indicated by the manometer by referring to Figure 31. In order to obtain an accurate measurement, be certain that the air filters are clean.
5. To adjust Measured CFM to Required CFM, see SUPPLY AIR DRIVE ADJUSTMENT.
6. After readings have been obtained, remove the tubes and replace the dot plugs.

⚠WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

Method Two

1. Drill two 5/16 inch holes, one in the return air duct as close to the inlet of the unit as possible, and another in the supply air duct as close to the outlet of the unit as possible.
2. Using the whole drilled in step 1, insert eight inches of 1/4 inch metal tubing into the airflow of the return and supply air ducts of the unit.

NOTE: The tubes must be inserted and held in position perpendicular to the airflow so that velocity pressure will not affect the static pressure readings.

3. Use an Inclined Manometer or Magnehelic to determine the pressure drop across the unit. This is the External Static Pressure (ESP). In order to obtain an accurate measurement, be certain that the air filters are clean.
4. Determine the number of turns the variable motor sheave is open.
5. Select the correct blower performance table for the unit from Tables 16 and 17. Tables are presented for side and downflow configuration.
6. Determine the unit Measured CFM from the Blower Performance Table, External Static Pressure and the number of turns the variable motor sheave is open.
7. To adjust Measured CFM to Required CFM, see SUPPLY AIR DRIVE ADJUSTMENT.
8. After reading has been obtained, remove the tubes and seal holes.

NOTE: With the addition of field installed accessories repeat this procedure.

⚠WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

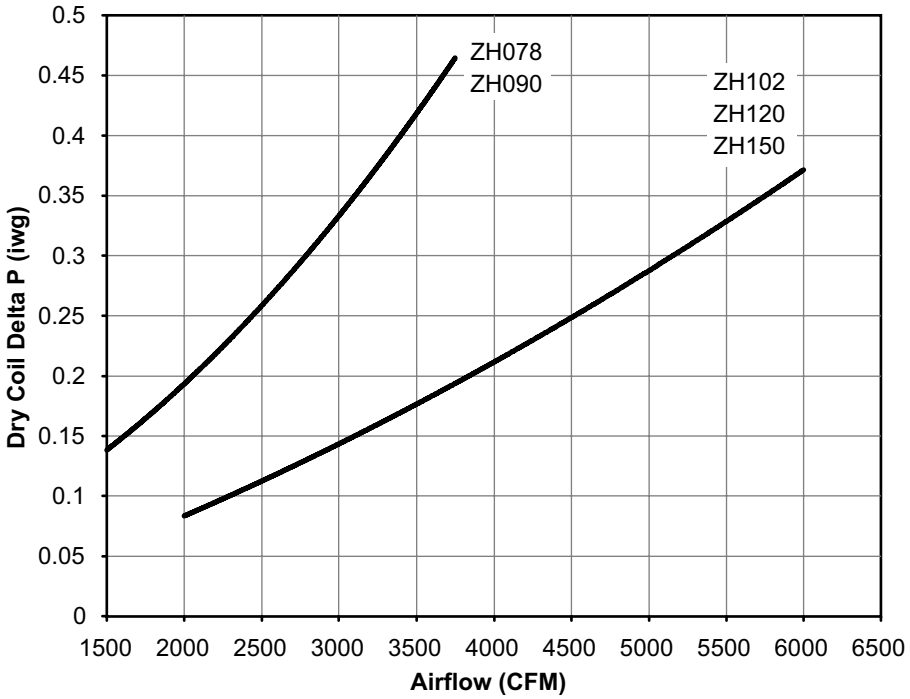


Figure 31: Dry Coil Delta P

Supply Air Drive Adjustment

⚠ CAUTION

Before making any blower speed changes review the installation for any installation errors, leaks or undesirable systems effects that can result in loss of airflow.

Even small changes in blower speed can result in substantial changes in static pressure and BHP. BHP and AMP draw of the blower motor will increase by the cube of the blower speed. Static pressure will increase by the square of the blower speed. Only qualified personnel should make blower speed changes, strictly adhering to the fan laws.

At unit start-up, the measured CFM may be higher or lower than the required CFM. To achieve the required CFM, the speed of the drive may have adjusted by changing the datum diameter (DD) of the variable pitch motor sheave as described below:

$$\left(\frac{\text{4,000 CFM}}{\text{3,800 CFM}}\right) \bullet \text{4.0 in.} = \text{4.21 in.}$$

Use the following tables and the DD calculated per the above equation to adjust the motor variable pitch sheave.

EXAMPLE

A 12.5 ton unit was selected to deliver 4,000 CFM with a 3 HP motor, but the unit is delivering 3,800 CFM. The variable pitch motor sheave is set at 2 turns open.

Use the equation to determine the required DD for the new motor sheave,

$$\left(\frac{\text{Required CFM}}{\text{Measured CFM}}\right) \bullet \text{Existing DD} = \text{New DD}$$

Use Table 20 to locate the DD nearest to 4.21 in. Close the sheave to 1 turn open.

New BHP

= (Speed increase)^3 • BHP at 3,800 CFM

= (Speed increase)^3 • Original BHP

= New BHP

New motor Amps

= (Speed increase)^3 • Amps at 3,800 CFM

= (Speed increase)^3 • Original Amps

= New Amps

Table 20: Motor Sheave Datum Diameters

1VM50x7/8 (1-1/2, 2 & 3 HP Motor)		1VP56x1-1/8 (5 HP Motor)	
Turns Open	**Datum Diameter**	**Turns Open**	**Datum Diameter**
0	4.4	1	5.3
1/2	4.3	1-1/2	5.2
1	4.2	2	5.1
1-1/2	4.1	2-1/2	5.0
2	4.0	3	4.9
2-1/2	3.9	3-1/2	4.8
3	3.8	4	4.7
3-1/2	3.7	4-1/2	4.6
4	3.6	5	4.5
4-1/2	3.5	5-1/2	4.4
5	3.4	6	4.3

Table 21: Additional Static Resistance

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	Electric Heat kW[2]				
					95	18	24	36	54
078 (6.5) 090 (7.5)	ZH	1900	0.00	0.07	0.05	0.06	0.07	0.08	0.10
		2100	-0.01	0.09	0.06	0.07	0.08	0.09	0.11
		2300	-0.01	0.11	0.07	0.08	0.09	0.10	0.13
		2500	-0.02	0.13	0.08	0.09	0.10	0.11	0.14
		2700	-0.03	0.16	0.09	0.10	0.12	0.13	0.16
		2900	-0.04	0.18	0.10	0.11	0.13	0.14	0.18
		3100	-0.05	0.20	0.12	0.13	0.15	0.16	0.20
		3300	-0.06	0.22	0.13	0.14	0.17	0.18	0.22
		3500	-0.07	0.24	0.15	0.16	0.19	0.20	0.24
		3700	-0.08	0.27	0.17	0.18	0.21	0.22	0.26
		3900	-0.09	0.29	0.19	0.20	0.23	0.24	0.28
		4100	-0.09	0.31	0.21	0.22	0.25	0.26	0.31
		4300	-0.10	0.30	0.23	0.24	0.28	0.29	0.34
		4500	-0.11	0.35	0.25	0.26	0.30	0.31	0.37
102 (8.5) 120 (10) 150 (12.5)	ZH	1900	0.06	0.02	0.05	0.06	0.07	0.08	0.10
		2100	0.07	0.02	0.06	0.07	0.08	0.09	0.11
		2300	0.08	0.02	0.07	0.08	0.09	0.10	0.13
		2500	0.09	0.02	0.08	0.09	0.10	0.11	0.14
		2700	0.11	0.03	0.09	0.10	0.12	0.13	0.16
		2900	0.12	0.03	0.10	0.11	0.13	0.14	0.18
		3100	0.14	0.03	0.12	0.13	0.15	0.16	0.20
		3300	0.16	0.03	0.13	0.14	0.17	0.18	0.22
		3500	0.18	0.04	0.15	0.16	0.19	0.20	0.24
		3700	0.20	0.04	0.17	0.18	0.21	0.22	0.26
		3900	0.23	0.04	0.19	0.20	0.23	0.24	0.28
		4100	0.25	0.04	0.21	0.22	0.25	0.26	0.31
		4300	0.28	0.05	0.23	0.24	0.28	0.29	0.34
		4500	0.30	0.05	0.25	0.26	0.30	0.31	0.37
		4700	0.33	0.05	0.28	0.29	0.33	0.34	0.40
		4900	0.36	0.05	0.30	0.31	0.35	0.37	0.43
		5100	0.39	0.06	0.33	0.34	0.38	0.40	0.46
		5300	0.42	0.06	0.35	0.37	0.41	0.43	0.49
		5500	0.45	0.06	0.38	0.40	0.44	0.46	0.53
		5700	0.48	0.06	0.41	0.43	0.47	0.49	0.56
		5900	0.52	0.07	0.44	0.46	0.50	0.53	0.59
		6100	0.56	0.07	0.47	0.49	0.53	0.56	0.62
		6300	0.60	0.07	0.50	0.53	0.56	0.59	0.65

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Operation

Cooling Sequence Of Operation

For the Predator® series of units, the thermostat makes a circuit between "R" and "Y1" for the first stage of cooling.

The call is passed to the **Unit Control Board (UCB),** which then determines whether the requested operation is available and, if so, which components to energize.

For gas heating, the UCB monitors the "W1" call but does not handle the operation of the gas furnace. An ignition control board controls the gas heater operation. For electric heat units, the UCB passes the call to the electric heater. In both cases, when the "W1" call is sensed, the indoor air blower is energized following a specified heating delay.

If at any time a call for both heating and cooling are present, the heating operation will be performed. If operating, the cooling system is halted as with a completion of a call for cooling. Heating always takes priority.

Continuous Blower

By setting the room thermostat fan switch to "ON," the supply air blower will operate continuously.

Intermittent Blower

With the room thermostat fan switch set to "AUTO" and the system switch set to either the "AUTO" or "HEAT" settings, the blower is energized whenever a cooling or heating operation is requested. The blower is energized after any specified delay associated with the operation.

When energized, the indoor blower has a minimum run time of 30 seconds. Additionally, the indoor blower has a delay of 10 seconds between operations.

No Outdoor Air Options

When the thermostat calls for the first stage of cooling, the low-voltage control circuit from “R” to “Y1” and “G” is completed. The UCB energizes the economizer (if installed and free cooling is available) or the first available compressor* and the condenser fans. For first stage cooling, compressor #1 is energized. If compressor #1 is unavailable, compressor #2 is energized. After completing the specified fan on delay for cooling, the UCB will energize the blower motor.

When the thermostat calls for the second stage of cooling, the low-voltage control circuit from “R” to “Y2” is completed. The control board energizes the first available compressor. If free cooling is being used for the first stage of cooling, compressor #1 is energized. If compressor #1 is active for first stage cooling or the first compressor is locked-out, compressor #2 is energized. In free-cooling mode, if the call for the second stage of cooling continues for 20 minutes, compressor #2 is energized, provided it has not been locked-out.

If there is an initial call for both stages of cooling, the UCB will delay energizing compressor #2 by 30 seconds in order to avoid a power rush.

Once the thermostat has been satisfied, it will de-energize Y1 and Y2. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling.

* To be available, a compressor must not be locked-out due to a high or low-pressure switch or freezestat trip and the **Anti-Short Cycle Delay (ASCD)** must have elapsed.

Economizer With Single Enthalpy Sensor

When the room thermostat calls for "first-stage" cooling, the low voltage control circuit from "R" to "G" and "Y1" is completed. The UCB energizes the blower motor (if the fan switch on the room thermostat is set in the "AUTO" position) and drives the economizer dampers from fully closed to their minimum position. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (previously determined), "Y1" energizes the economizer. The dampers will modulate to maintain a constant supply air temperature as monitored by the discharge air sensor. If the outdoor air enthalpy is above the set point, "Y1" energizes compressor #1.

When the thermostat calls for "second-stage" cooling, the low voltage control circuit from "R" to "Y2" is completed. The UCB energizes the first available compressor. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (i.e. first stage has energized the economizer), "Y2" will energize compressor #1. If the outdoor air is above the set point, "Y2" will energize compressor #2.

Once the thermostat has been satisfied, it will de-energize “Y1” and “Y2”. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling, and the economizer damper goes to the closed position. If the unit is in continues fan operation, the economizer damper goes to the minimum position.

Economizer With Dual Enthalpy Sensors

The operation with the dual enthalpy sensors is identical to the single sensor except that a second enthalpy sensor is mounted in the return air. This return air sensor allows the economizer to choose between outdoor air and return air, whichever has the lowest enthalpy value, to provide maximum operating efficiency.

Economizer With Power Exhaust

A unit equipped with an economizer (single or dual enthalpy) and a power exhaust operates as specified above with one

addition. The power exhaust motor is energized 45 seconds after the actuator position exceeds the exhaust fan set point on the economizer control. When the power exhaust is operating, the second stage of mechanical cooling will not operate. As always, the "R" to "G" connection provides minimum position but does not provide power exhaust operation.

Motorized Outdoor Air Dampers

This system operation is the same as the units with no outdoor air options with one exception. When the "R" to "G" circuit is complete, the motorized damper drives open to a position set by the thumbwheel on the damper motor. When the "R" to "G" circuit is opened, the damper spring returns fully closed.

Cooling Operation Errors

Each cooling system is monitored for operation outside of the intended parameters. Errors are handled as described below. All system errors override minimum run times for compressors.

High-Pressure Limit Switch

During cooling operation, if a high-pressure limit switch opens, the UCB will de-energize the associated compressor, initiate the ASCD (Anti-short cycle delay), and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a high-pressure switch open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (see Table 29). If the other compressor is inactive, the condenser fans will be de-energized.

Low-Pressure Limit Switch

The low-pressure limit switch is not monitored during the initial 30 seconds of a cooling system's operation. For the following 30 seconds, the UCB will monitor the low-pressure switch to ensure it closes. If the low-pressure switch fails to close after the 30-second monitoring phase, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans.

Once the low-pressure switch has been proven (closed during the 30-second monitor period described above), the UCB will monitor the low-pressure limit switch for any openings. If the low-pressure switch opens for greater than 5 seconds, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans.

If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a low-pressure switch open three times within one hour of operation, the UCB will lock-out the associated compressor and flash a code (Table 29). If the other compressor is inactive, the condenser fans will be de-energized.

Freezestat

During cooling operation, if a freezestat opens, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a freezestat open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (Table 29). If the other compressor is inactive, the condenser fans will be de-energized.

Low Ambient Cooling

To determine when to operate in low ambient mode, the UCB has a pair of terminals connected to a temperature-activated switch set at 45ºF. When the low ambient switch is closed and the thermostat is calling for cooling, the UCB will operate in the low ambient mode.

Low ambient mode operates the compressors in this manner: 10 minutes on, 5 minutes off. The indoor blower is operated throughout the cycle. The 5-minute off period is necessary to defrost the indoor coil.

Low ambient mode always begins with compressor operation. Compressor minimum run time may extend the minutes of compressor operation. The defrost cycle will begin immediately following the elapse of the minimum run time.

When operating in low ambient mode, the UCB will not lockout the compressors due to a freezestat trip. However, a freezestat trip will de-energize the associated compressor. If the call for cooling is still present at the end of the ASCD and the freezestat has closed, the unit will resume operation.

Safety Controls

The unit control board monitors the following inputs for each cooling system:

1. A suction line freezestat to protect against low evaporator temperatures due to a low airflow or a low return air temperature, (opens at 26 ± 5 °F and resets at 38 ± 5°F).
2. A high-pressure switch to protect against excessive discharge pressures due to a blocked condenser coil or a condenser motor failure, (opens at 625 ± 25 psig).
3. A low-pressure switch to protect against loss of refrigerant charge, (opens at 7 ± 3 psig).

The above pressure switches are hard-soldered to the unit. The refrigeration systems are independently monitored and controlled. On any fault, only the associated system will be affected by any safety/preventive action. The other refrigerant system will continue in operation unless it is affected by the fault as well.

The unit control board monitors the temperature limit switch of electric heat units and the temperature limit switch and the gas valve of gas furnace units.

Compressor Protection

In addition to the external pressure switches, the compressors also have inherent (internal) protection. If there is an abnormal temperature rise in a compressor, the protector will open to shut down the compressor. The UCB incorporates features to minimize compressor wear and damage. An **Anti-Short Cycle Delay (ASCD)** is utilized to prevent operation of a compressor too soon after its previous run. Additionally, a minimum run time is imposed any time a compressor is energized.

The ASCD is initiated on unit start-up and on any compressor reset or lock-out.

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 29.

Reset

Remove the call for cooling, by raising thermostat setting higher than the conditioned space temperature. This resets any pressure or freezestat flash codes.

Electric Heating Sequence Of Operations

The following sequence describes the operation of the electric heat section.

Two-stage heating:

a. Upon a call for first stage heat by the thermostat, the heater relay (RA) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor. If the second stage of heat is required, heater relay (RB) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

b The thermostat will cycle the electric heat to satisfy the heating requirements of the conditioned space.

Electric Heat Operation Errors

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized.

This limit is monitored regardless of unit operation status, i.e. the limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and a flash code is initiated (See Table 29).

Safety Controls

The UCB monitors the temperature limit switch of electric heat units.

The control circuit includes the following safety controls:

Limit Switch (Ls)

This control is located inside the heater compartment and is set to open at the temperature indicated in the Electric Heat Limit Setting Tables 21 and 22. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

Table 22: Electric Heat Limit Setting 50" Cabinet

UNIT (TONS)	VOLTAGE	HEATER kW	LIMIT SWITCH OPENS °F
ZH102, 120, 150 (8.5, 10, 12.5)	208/230	18	150
		24	150
		34	150
		54	130
ZH102, 120, 150 (8.5, 10, 12.5)	480	18	150
		24	150
		34	150
		54	130
ZH102, 120, 150 (8.5, 10, 12.5)	600	18	150
		24	150
		34	150
		54	130

Table 23: Electric Heat Limit Setting 42" Cabinet

UNIT (TONS)	VOLTAGE	HEATER kW	LIMIT SWITCH OPENS °F
ZH078, 090 (6.5, 7.5)	208/230	9	135
		18	150
		24	165
		34	190
ZH078, 090 (6.5, 7.5)	480	9	135
		18	150
		24	165
		34	185
ZH078, 090 (6.5, 7.5)	600	9	135
		18	150
		24	150
		34	185

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 29.

Reset

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature.This resets any flash codes.

Electric Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the

value below the correct setpoint will give shorter “ON” cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 23 for the required electric heat anticipator setting.

Table 24: Electric Heat Anticipator Setpoints

SETTING, AMPS	
W1	**W2**
0.13	0.1

Gas Heating Sequence Of Operations

When the thermostat calls for the first stage of heating, the low-voltage control circuit from “R” to “W1” is completed. A call for heat passes through the UCB to the **Ignition Control Board (ICB).** The UCB monitors the “W1” call and acts upon any call for heat by monitoring the **Gas Valve (GV).** Once voltage has been sensed at the GV, the UCB will initiate the fan on delay for heating, energizing the indoor blower the specified delay has elapsed.

When the thermostat has been satisfied, heating calls are ceased. The GV is immediately closed. The blower is de-energized after the fan off delay for heating has elapsed. The draft motor performs a 30-second post purge.

Ignition Control Board

First Stage Of Heating

When the ICB receives a call for first stage of heating, “W1,” the draft motor is energized. Once the draft motor has been proven, a 30-second purge is initiated. At the end of the purge, the GV is opened, and the spark ignitor is energized for 10 seconds. The ICB then checks for the presence of flame. If flame is detected, the ICB enters a flame stabilization period. If flame was not detected, the GV closes, and a retry operation begins.

During the flame stabilization period, a loss of the flame for 2 seconds will cause the GV to close and the retry operation to begin. After the flame stabilization period, a loss of flame for 3/4 second will cause the GV to close and the retry operation to begin.

At the conclusion of the flame stabilization period, the ICB will operate the gas heat in high fire for an additional 60 seconds (for a total for 120 seconds of high fire operation). After this 60 seconds, the ICB will then use the call for the second stage of heat to control second stage operation of the GV.

When “W1” is satisfied, both valves are closed.

Second Stage Of Heating

When the ICB receives a call for the second stage of heating, “W2,” the ICB conducts a complete first stage ignition sequence. If this sequence is satisfied, the second main valve of the GV is opened.

When “W2” is satisfied, the second main valve is closed.

Retry Operation

When a flame is lost or is not detected during an attempt to achieve ignition, a retry operation occurs. A 30-second purge is performed between ignition attempts.

If the unit fails after three ignition attempts, the furnace is locked-out for one hour. The furnace is monitored during this one-hour period for unsafe conditions.

Recycle Operation

When a flame is lost after the flame stabilization period, a recycle operation occurs. If the unit fails after five recycle attempts, the furnace is locked-out for one hour.

Gas Heating Operation Errors

Lock-Out

A one-hour lockout occurs following three retries or five recycles. During the one-hour lockout, flame detection, limit conditions, and main valves are tested. Any improper results will cause the appropriate action to occur. Recycling the low voltage power cancels the lock-out.

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized. When the UCB again senses 24 volts from the temperature limit, the draft motor will perform a 15-second post-purge and the indoor blower will be de-energized following the elapse of the fan off delay for heating.

This limit is monitored regardless of unit operation status, i.e. this limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and flash code is initiated (See Table 29).

Flame Sense

Flame sensing occurs at all times. If “W1” is not present and a flame is sensed for 2 seconds, the draft motor is energized and the GV is kept off. The ICB halts any operation until a flame is not detected. Once the flame detection is lost, the ICB performs a post-purge. Normal operation is allowed concurrently with the purge (i.e. this purge can be considered the purge associated with a call for “W1”).

If “W1” is present, a flame is sensed, but the GV is not energized, the draft motor is energized until the flame detection is lost. Normal operation is now allowed.

The flame detection circuitry continually tests itself. If the ICB finds the flame detection circuitry to be faulty, the ICB will not permit an ignition sequence and the draft motor is energized. If this failure should occur during an ignition cycle the failure is counted as a recycle.

Gas Valve

The UCB and ICB continuously monitor the GV.

If the ICB senses voltage at the GV when not requested, the ICB will energize the draft motor. The ICB will not operate the furnace until voltage is no longer sensed at the GV. The draft motor is stopped when voltage is not sensed at the GV.

Any time the UCB senses voltage at the GV without a call for heat for a continuous five-minute period, the UCB will lock-on the indoor blower and a flash code is initiated (Table 29). When voltage is no longer sensed at the GV, the UCB will de-energize the indoor blower following the elapse of the fan off delay for heating.

If voltage has been sensed at the GV for at least 15 seconds during the fan on delay for heating and GV voltage or “W1” is lost, the indoor blower is forced on for the length of the fan off delay for heating.

During a call for heat, if the UCB does not sense voltage at the GV for a continuous five-minute period the UCB will initiate a flash code (Table 29). The indoor blower motor will not be locked-on while there is no GV voltage.

Safety Controls

The UCB monitors the temperature limit switch of gas heat units.

The control circuit includes the following safety controls:

Limit Switch (LS)

This control is located inside the gas heat compartment and is set to open at the temperature indicated in the Gas Heat Limit Control Settings Table 24. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

Auxiliary Limit Switch (ALS)

This control is located inside the supply air compartment and is set to open at the temperature indicated in the Gas Heat Limit Control Settings Table 24. It resets manually. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

The auxiliary limit switch is wired in series with the limit switch. As such, the UCB cannot distinguish the auxiliary limit and the gas heat limit switch operation except the auxiliary is manual reset. Consequently, the control will respond in the same manner as outlined above under “Limit Switch”.

Table 25: Gas Heat Limit Control Settings[1]

Unit		Main Limit Setting °F
Size	Opt.	
ZH078	10	165
	15	165
ZH090	10	165
	15	165
ZH102	10	215
	15	195
ZH120	15	195
	20	160
ZH150	15	195
	20	160

1. Rollout = 300°F, Auxiliary Limit = 200°F.

The ICB monitors the Pressure and Rollout switches of gas heat units.

The control circuit includes the following safety controls:

Pressure Switch (PS)

Once the draft motor has reached full speed and closes the pressure switch during a normal ignition sequence, if the pressure sw opens for 2 seconds, the GV will be de-energized, the ignition cycle is aborted, and the ICB flashes the appropriate code. See Table 30 Ignition Control Flash Codes. The draft motor is energized until the pressure switch closes or “W1” is lost.

Rollout Switch (ROS)

The rollout switch is wired in series with the pressure switch. As such, the ICB cannot distinguish the rollout switch operation from that of the pressure switch.

Consequently, the control will only respond in the same manner as outlined above under “Pressure Switch”. An open rollout will inhibit the gas valve from actuating.

Internal Microprocessor Failure

If the ICB detects an internal failure, it will cease all outputs, ignore inputs, and display the proper flash code for control replacement. The ICB remains in this condition until replaced.

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 29.

Resets

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature. This resets any flash codes.

Gas Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint will give shorter “ON cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 26 for the required gas heat anticipator setting.

Table 26: Gas Heat Anticipator Setpoints

SETTING, AMPS	
W1	**W2**
0.65	0.1

Start-Up (Cooling)

Prestart Check List

After installation has been completed:

1. Check the electrical supply voltage being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Set the room thermostat to the off position.
3. Turn unit electrical power on.
4. Set the room thermostat fan switch to on.
5. Check indoor blower rotation.
   - If blower rotation is in the wrong direction. Refer to Phasing Section in general information section.

   Check blower drive belt tension.
6. Check the unit supply air (CFM).
7. Measure evaporator fan motor's amp draw.
8. Set the room thermostat fan switch to off.
9. Turn unit electrical power off.

Operating Instructions

1. Turn unit electrical power on.

NOTE: Prior to each cooling season, the crankcase heaters must be energized at least 10 hours before the system is put into operation.

2. Set the room thermostat setting to lower than the room temperature.
3. First stage compressors will energize after the built-in time delay (five minutes).
4. The second stage of the thermostat will energize second stage compressor if needed.

Post Start Check List

1. Verify proper system pressures for both circuits.
2. Measure the temperature drop across the evaporator coil.

Start-Up (Gas Heat)

Pre-Start Check List

Complete the following checks before starting the unit.

1. Check the type of gas being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Make sure that the vent outlet and combustion air inlet are free of any debris or obstruction.

Operating Instructions

⚠ CAUTION

This furnace is equipped with an automatic re-ignition system. DO NOT attempt to manually light the pilot.

Lighting The Main Burners

1. Turn “OFF” electric power to unit.
2. Turn room thermostat to lowest setting.
3. Turn gas valve counter-clockwise to “ON” position (See Figure 33).
4. Turn “ON” electric power to unit.
5. If thermostat set temperature is above room temperature, the main burners will ignite. If a second stage of heat is called for, the main burners for second stage heat will ignite for the second stage heat.

Post Start Checklist

After the entire control circuit has been energized and the heating section is operating, make the following checks:

1. Check for gas leaks in the unit piping as well as the supply piping.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

2. Check for correct manifold gas pressures. (See CHECKING GAS INPUT.)
3. Check the supply gas pressure. It must be within the limits shown on the rating nameplate. Supply pressure should be checked with all gas appliances in the building at full fire. At no time should the standby gas pressure exceed 10.5 in. or the operating pressure drop below 4.5 in for natural gas units. If gas pressure is outside these limits, contact the local gas utility or propane supplier for corrective action.

Shut Down

1. Set the thermostat to the lowest temperature setting.
2. Turn “OFF” all electric power to unit.
3. Open gas heat access panel.
4. Turn gas valve clockwise to “OFF” position (See Figure 33).

Checking Gas Heat Input

This unit has two stages of gas heat. The first stage is 60% of the full fire input and is considered the minimum input for the furnace. The intended input for each furnace is shown in Table 27. The table applies to units operating on 60 Hz power only.

To determine the rate of gas flow (Second Stage).

1. Turn off all other gas appliances connected to the gas meter.
2. Turn on the furnace and make sure the thermostat is calling for Second stage (100% input) heat.
3. Measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical gas meter has a 1/2 or a 1 cubic foot test dial.
4. Using the number of seconds it takes for one revolution of the dial, calculate the cubic feet of gas consumed per hour. (See example below).
5. If necessary, adjust the high pressure regulator as discussed in the section “Manifold Gas Pressure Adjustment”. **Be sure not to over-fire** the furnace on Second stage. If in doubt, it is better to leave the Second stage of the furnace slightly under-fired. Repeat Steps 1-5.

To determine the rate of gas flow (First Stage)

1. Turn off all other gas appliances connected to the gas meter.
2. Turn on the furnace and make sure the thermostat is calling for first stage (60% input) heat.
3. Even when the thermostat is calling for first stage heat, the unit will light on second stage and will run on Second stage for 1 minute. Allow this one-minute time period to expire and be certain the unit is running on first stage.
4. Measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical gas meter has a 1/2 or a 1 cubic foot test dial.
5. Using the number of seconds it takes for one revolution of the dial, calculate the cubic feet of gas consumed per hour (See example below).
6. If necessary, adjust the low pressure regulator as discussed in the section “Manifold Gas Pressure Adjustment”. **Be sure not to under-fire** the furnace on first stage. If in doubt, it is better to leave the first stage of the furnace slightly over-fired (greater than 60% input). Repeat Steps 1-6.

Table 27: Gas Rate Cubic Feet Per Hour

Seconds for One Rev.	Size of Test Dial	
	1/2 cu. ft.	1 cu. ft.
10	180	360
12	150	300
14	129	257
16	113	225
18	100	200
20	90	180
22	82	164
24	75	150
26	69	138
28	64	129
30	60	120
32	56	113
34	53	106
36	50	100
38	47	95
40	45	90
42	43	86
44	41	82
46	39	78
48	37	75
50	36	72
52	35	69
54	34	67
56	32	64
58	31	62
60	30	60

NOTE: To find the Btu input, multiply the number of cubic feet of gas consumed per hour by the Btu content of the gas in your particular locality (contact your gas company for this information as it varies widely from area to area).

EXAMPLE

By actual measurement, it takes 19 seconds for the hand on a 1 cubic foot dial to make a revolution with a 192,000 Btuh furnace running. To determine rotations per minute, divide 60 by 19 = 3.16. To calculate rotations per hour, multiply 3.16 • 60 = 189.6. Multiply 189.6 • 1 (0.5 if using a 1/2 cubic foot dial) = 189.6. Multiply 189.6 • (the Btu rating of the gas). For this example, assume the gas has a Btu rating of 1050 Btu/ft.^{3}. The result of 199,000 Btuh is within 5% of the 192,000 Btuh rating of the furnace.

Manifold Gas Pressure Adjustment

This gas furnace has two heat stages. Therefore, the gas valve has two adjustment screws located under a plastic protective cover. The second stage (100% input) adjustment screw is adjacent to the “HI” marking on the valve and the first stage (60% input) adjustment screw is located adjacent to the “LO” marking on the valve (See Figure 33).

Manifold pressure adjustment procedure.

Adjust second stage (100% input) pressure first, then adjust first stage (60% input) pressure.

1. Turn off all power to the unit.
2. Using the outlet pressure port on the gas valve, connect a manometer to monitor the manifold pressure.
3. Remove plastic cap covering HI and LO pressure adjustment screws.
4. Turn on power to the unit.
5. Set thermostat to call for second stage heat and start furnace.
6. If necessary, using a screwdriver, turn the second stage adjustment screw (adjacent to the “HI” marking on the valve) clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure. **Be sure not to over-fire the unit on second stage**.
7. After the high manifold pressure has been checked, adjust the thermostat to call for first stage heat.
8. If necessary, using a screwdriver, turn the first stage adjustment screw (adjacent to the “LO” marking on the valve) clockwise to increase manifold pressure or counterclockwise to decrease manifold pressure. **Be sure not to under-fire the unit on first stage**.
9. Once pressure has been checked, replace the plastic cap covering the HI and LO pressure adjustment screws.

NOTE: When using natural gas, the manifold pressure for second stage (100% input) should be 3.5 IWG ± 0.3. The manifold pressure for first stage (60% input) when using natural gas should be 1.5 IWG ± 0.3.

Table 28: Gas Heat Stages

# of Burner Tubes	2nd Stage Input (100% Btuh)	1st Stage Input (60% Btuh)
4	120,000	72,000
6	180,000	108,000
8	240,000	144,000

Adjustment Of Temperature Rise

The temperature rise (the difference of temperature between the return air and the heated air from the furnace) must lie within the range shown on the CSA rating plate and the data in Table 11.

After the temperature rise has been determined, the CFM can be calculated as follows:

$$\text{CFM} = \text{Btu Input} \bullet \frac{0.8}{(1.08 \cdot \Delta°\text{F})}$$

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts (about 6 feet from the furnace) where they will not be affected by radiant heat. Increase the blower CFM to decrease the temperature rise; decrease the blower CFM to increase the rise (See SUPPLY AIR DRIVE ADJUSTMENT).

NOTE: Each gas heat exchanger size has a minimum allowable CFM. Below this CFM, the limit will open.

Burners/Orifices Inspection/Servicing

Before checking or changing burners, pilot or orifices, CLOSE MAIN MANUAL SHUT-OFF VALVE AND SHUT OFF ALL POWER TO THE UNIT.

1. Open the union fitting just upstream of the unit gas valve and downstream from the main manual shut-off valve in the gas supply line.
2. Remove the screws holding each end of the manifold to the manifold supports.
3. Disconnect wiring to the gas valves and spark igniter(s). Remove the manifold & gas valve assembly. Orifices can now be inspected and/or replaced.

To service burners, complete step 4.

4. Remove the heat shield on top of the manifold supports. Burners are now accessible for inspection and/or replacement.

NOTE: Reverse the above procedure to replace the assemblies.

Make sure that burners are level and seat at the rear of the gas orifice.

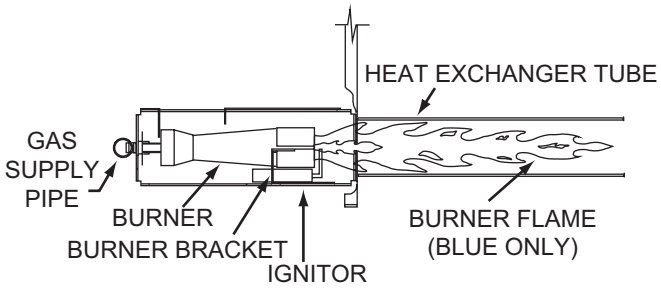


Figure 32: Typical Flame

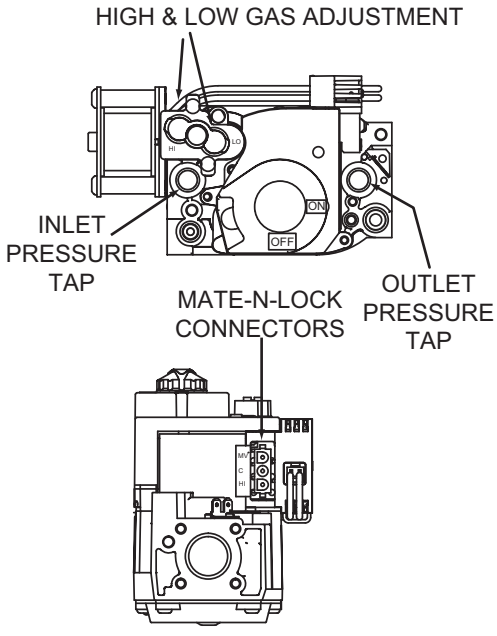


Figure 33: Typical Gas Valve

Charging The Unit

All ZH units use Thermal Expansion Devices. Charge the unit to 10° subcooling.

Troubleshooting

⚠WARNING

Troubleshooting of components may require opening the electrical control box with the power connected to the unit. **Use extreme care when working with live circuits!** Check the unit nameplate for the correct line voltage and set the voltmeter to the correct range before making any connections with line terminals.

When not necessary, shut off all electric power to the unit prior to any of the following maintenance procedures so as to prevent personal injury.

⚠ CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation which could cause injury to person and/or damage unit components. Verify proper operation after servicing.

Predator® Flash Codes

Various flash codes are utilized by the unit control board (UCB) to aid troubleshooting. Flash codes are distinguished by the short on and off cycle used (approximately 200ms on and 200ms off). To show normal operation, the control board flashes a 1 second on, 1 second off “heartbeat” during normal operation. This is to verify that the UCB is functioning correctly. Do not confuse this with an error flash code. To prevent confusion, a 1-flash, flash code is not used.

Current alarms are flashed on the UCB LED. The alarm history can be checked by pressing and releasing the ALARMS button on the UCB. The UCB will cycle through the last five (5) alarms, most recent to oldest, separating each alarm flash code by approximately 2 seconds.

In some cases, it may be necessary to “zero” the ASCD for the compressors in order to perform troubleshooting. To reset all ASCDs for one cycle, press and release the UCB TEST button once.

Table 29: Unit Control Board Flash Codes

Flash Code	Description
On Steady	Control Failure - Replace Control
Heart Beat	Normal Operation
1 Flash	Not Applicable
2 Flashes	Control waiting ASCD[1]
3 Flashes	HPS1 - Compressor Lock out
4 Flashes	HPS2 - Compressor Lock out
5 Flashes	LPS1 - Compressor Lock out
6 Flashes	LPS2 - Compressor Lock out
7 Flashes	FS1 - Compressor Lock out
8 Flashes	FS2 - Compressor Lock out
9 Flashes	Ignition Control Locked Out/ Ignition Control Failure / Limit Switch Trip / No Jumper Plug in Heat Section
10 Flashes	Compressors Locked Out On Low Outdoor Air Temperature[1]
11 Flashes	Compressors Locked Out Because The Economizer Is Using Free Cooling[1]
12 Flashes	Fan Overload Switch Trip - Not Applicable On This Unit
13 Flashes	Compressor Held Off Due To Low Voltage[1]
14 Flashes	EEPROM Storage Failure (Control Failure)
OFF	No Power or Control Failure

1. These flash codes do not represent alarms.

Table 30: Ignition Control Flash Codes

Flashes	Fault Conditions	Check
STEADY ON	Control Failure	Control
HEARTBEAT	Normal Operation	
1	Not Applicable	
2	Pressure Switch Stuck Closed	Pressure Switch
3	Pressure Switch Failed To Close	Venter Pressure Switch Vent Blocked
4	Limit Switch Open	Main Limit AUX Limit
5	Flame Present With Gas Off First Stage Gas Valve Energized With W1 Off Second Stage Gas Valve Energized With First Stage Gas Valve Off	Gas Valve
6	Ignition Lockout	Gas Flow Gas Pressure Gas Valve Flame Sensor
STEADY OFF	No Power Or Control Failure	24VAC or Control

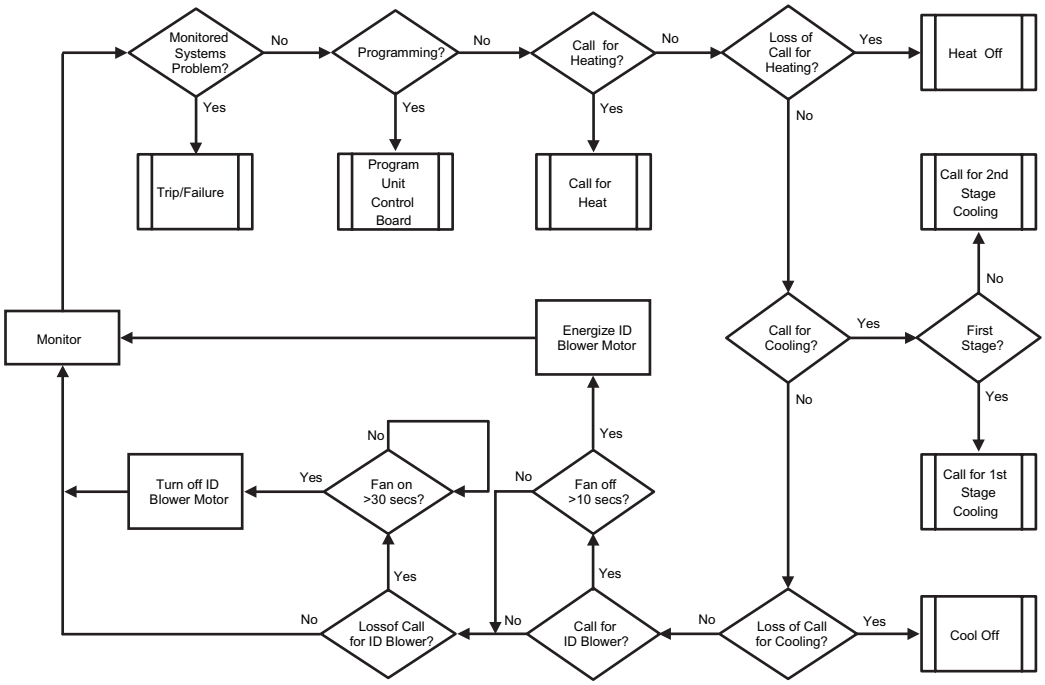


Figure 34: Basic Troubleshooting Flowchart

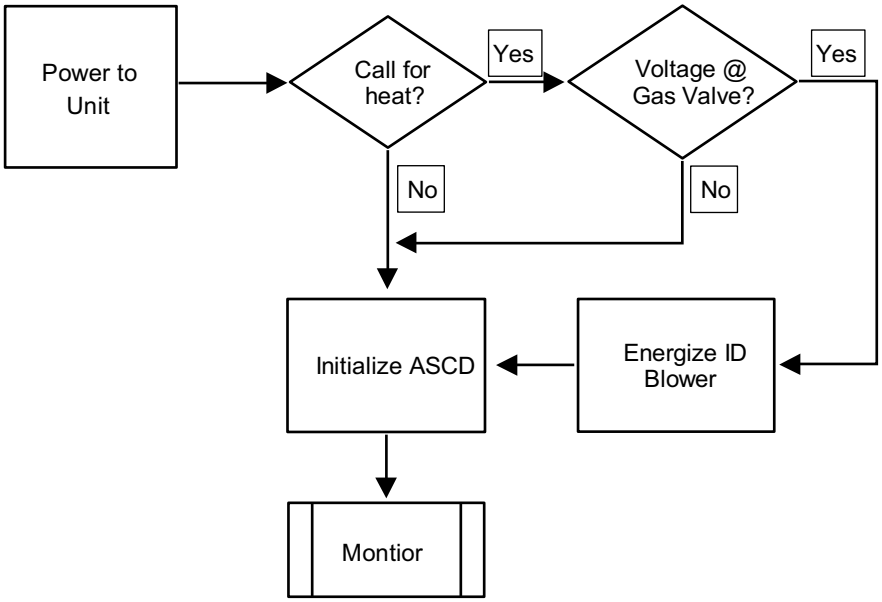
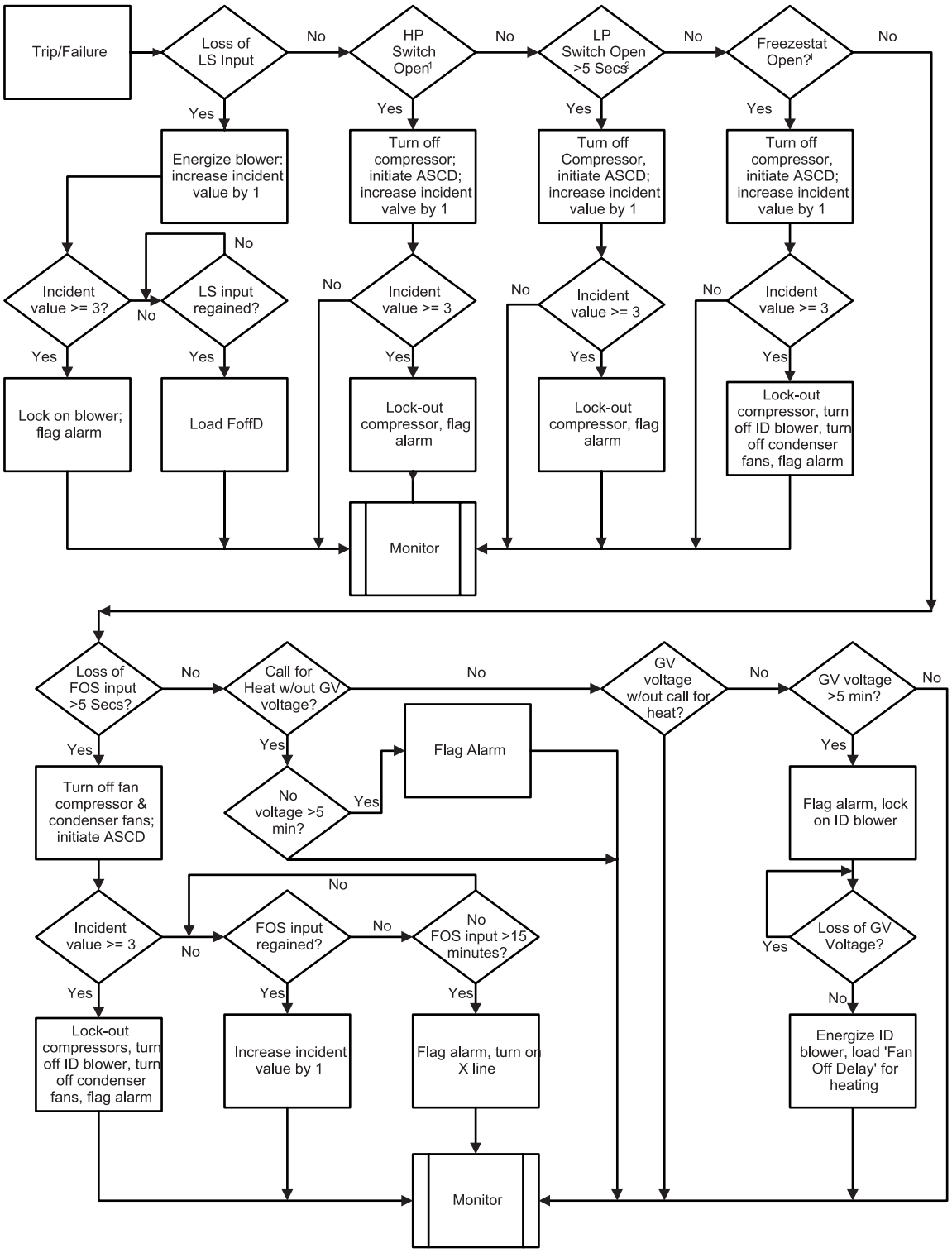


Figure 35: Power On Flow Chart


Trip/Failure
Loss of LS Input
No
HP Switch Open1
No
LP Switch Open >5 Secs2
No
Freezestat Open?1
No
Yes
Energize blower: increase incident value by 1
Turn off compressor; initiate ASCD; increase incident valve by 1
Turn off Compressor, initiate ASCD; increase incident value by 1
Turn off compressor, initiate ASCD; increase incident value by 1
Incident value >= 3?
No
LS input regained?
Incident value >= 3
Incident value >= 3
Incident value >= 3
Lock on blower; flag alarm
Load FoffD
Lock-out compressor, flag alarm
Lock-out compressor, flag alarm
Lock-out compressor, turn off ID blower, turn off condenser fans, flag alarm
Monitor
Loss of FOS input >5 Secs?
Call for Heat w/out GV voltage?
GV voltage w/out call for heat?
GV voltage >5 min?
Flag Alarm
Turn off fan compressor & condenser fans; initiate ASCD
No voltage >5 min?
Flag alarm, lock on ID blower
Incident value >= 3
FOS input regained?
No FOS input >15 minutes?
Loss of GV Voltage?
Lock-out compressors, turn off ID blower, turn off condenser fans, flag alarm
Increase incident value by 1
Flag alarm, turn on X line
Energize ID blower, load 'Fan Off Delay' for heating
Monitor

1 The control board only monitors the input when the compressor really is energized.
2 The low-pressure switch is not monitored for the first 30 seconds of compressor activity. The control board then monitors the switch to ensure it closes. If the switch remains open and additional 30 seconds, the control board turns off the associated compressor and initiates the ASCD. Once it has closed during the start up period, the control board no longer handles the low-pressure switch differently than other inputs.

Figure 36: Trip Failure Flow Chart

Cooling Troubleshooting Guide

On calls for cooling, if the compressors are operating but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in the “AUTO” position):

1. Turn the thermostat fan switch to the ON position. If the supply air blower motor does not energize, go to Step 3.
2. If the blower motor runs with the fan switch in the ON position but will not run after the first compressor has energized when the fan switch is in the AUTO position, check the room thermostat for contact between R and G in the AUTO position during calls for cooling.
3. If the supply air blower motor does not energize when the fan switch is set to ON, check that line voltage is being supplied to the contacts of the M3, contactor, and that the contactor is pulled in. Check for loose wiring between the contactor and the supply air blower motor.
4. If M3 is pulled in and voltage is supplied to M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on internal protection. Cancel any thermostat calls and set the fan switch to AUTO. Wait for the internal overload to reset. Test again when cool.
5. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts are present at M3 but M3 is not pulled in, replace the contactor.
6. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.
7. If 24 volts is not present at M3, check that 24 volts is present at the UCB supply air blower motor terminal, “FAN”. If 24 volts is present at the FAN, check for loose wiring between the UCB and M3.
8. If 24 volts is not present at the “FAN” terminal, check for 24 volts from the room thermostat. If 24 volts are not present from the room thermostat, check for the following:
   a. Proper operation of the room thermostat (contact between R and G with the fan switch in the ON position and in the AUTO position during operation calls).
   b. Proper wiring between the room thermostat and the UCB, and
   c. Loose wiring from the room thermostat to the UCB
9. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
10. If the thermostat and UCB are properly wired, replace the UCB.

On calls for cooling, the supply air blower motor is operating but compressor #1 is not (the room thermostat fan switch is in the “AUTO” position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling and the compressors will not immediately operate. If both stages of cooling are requested simultaneously and the economizer provides free cooling, following a short delay compressor #1 will be energized unless it is locked out. If compressor #1 is locked out, compressor #2 is energized. Compressor #2 is always energized in place of compressor #1 when compressor #1 is requested but locked out.
2. If no economizer is installed or the economizer is not opening to provide free cooling and compressor #1 does not energize on a call for cooling, check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts are present and M1 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.
7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts is not present from the room thermostat, check for the following:
   a. 24 volts at the thermostat Y1 terminal
   b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.
9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing an alarm code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, cancel any call for cooling. This will reset any compressor lock outs.

NOTE: While the above step will reset any lockouts, compressor #1 may be held off for the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked

out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.

11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 “OUT” terminal of the UCB. If 24 volts is present, trace the wiring from Y1 “OUT” for incorrect wiring. If 24 volts is not present at the Y1 “OUT” terminal, the UCB must be replaced.
12. *For units without economizers*: If 24 volts is present at the Y1 OUT terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 “ECON” terminal.
13. *For units with economizers*: If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 “ECON” terminal. If nothing is found, the economizer control may have faulted and is failing to return the 24-volt “call” to the Y1 “ECON” terminal even though the economizer is not providing free cooling. To test, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB’s Mate-N-Lock plug. If compressor #1 energizes, there is a fault in the economizer wiring or the economizer control.
14. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local York distributors can test the UCB for this programming.
15. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.
16. If none of the above correct the error, replace the UCB.

On calls for the second stage of cooling, the supply air blower motor and compressor #1 are operating but compressor #2 is not (the room thermostat fan switch is in the “AUTO” position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling. If the second stage of cooling is requested, following a short delay, compressor #1 will be energized unless it is locked out. Typically, compressor #2 is energized only during free cooling if the call for the second stage of cooling persists for 20 minutes.
2. Compressor #2 will not energize simultaneously with compressor #1 if a call for both stages of cooling is received. The UCB delays compressor #2 by 30 seconds to prevent a power surge. If after the delay compressor #2 does not energize on a second stage call for cooling, check for line voltage at the compressor contactor, M2, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M2 is pulled in and voltage is supplied at M2, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M2 is not pulled in, check for 24 volts at the M2 coil. If 24 volts is present and M2 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M2, M2 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M2, check for 24 volts at the UCB terminal, C2. If 24 volts are present, check for loose wiring between C2 and the compressor contactor.
7. If 24 volts is not present at the C2 terminal, check for 24 volts from the room thermostat at the UCB Y2 terminal. If 24 volts is not present from the room thermostat, check for the following:
   a. 24 volts at the thermostat Y2 terminal
   b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the UCB Y2 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS2, LPS2, and FS2 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS2 has opened, there will be 24 volts of potential between the LPS2 terminals.
9. If 24 volts is present at the UCB Y2 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out,

   remove any call for cooling at the thermostat or by disconnecting the thermostat wiring at the Y2 UCB terminal. This will reset any compressor lock outs.

NOTE: While the above step will reset any lock outs, compressor #1 will be held off for the ASCD, and compressor #2 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y2 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.

11. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local York distributors can test the UCB for this programming.
12. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C2 terminal wire and jumper it to the Y2 terminal. DO NOT jump the Y2 to C2 terminals. If the compressor engages, the UCB has faulted.
13. If none of the above correct the error, replace the UCB.

On a call for cooling, the supply air blower motor and compressor #2 are operating but compressor #1 is not (the room thermostat fan switch is in the “AUTO” position):

1. Compressor #2 is energized in place of compressor #1 when compressor #1 is unavailable for cooling calls. Check the UCB for alarms indicating that compressor #1 is locked out. Press and release the ALARMS button if the LED is not flashing an alarm.
2. Check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts is present and M1 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.
7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts are not present at the UCB Y1 terminal, the UCB may have faulted. Check for 24 volts at the Y1 ECON terminal. If 24 volts is not present at Y1 “ECON”, the UCB has faulted. The UCB should de-energize all compressors on a loss of call for the first stage of cooling, i.e. a loss if 24 volts at the Y1 terminal.
8. If 24 volts are present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.
9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, remove any call for cooling. This will reset any compressor lock outs.

NOTE: While the above step will reset any lock outs, compressor #2 will be held off for the ASCD, and compressor #1 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.
11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 “OUT” terminal of the UCB. If 24 volts is present, trace the wiring from Y1 “OUT” for incorrect wiring. If 24 volts is not present at the Y1 “OUT” terminal, the UCB must be replaced.
12. *For units without economizers:* If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 “ECON” terminal.

    For units with economizers: If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 “ECON” terminal. The economizer control may have faulted and is not returning the 24 volts to the Y1 “ECON” terminal even though the economizer is not providing free cooling. To test the economizer control, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB’s Mate-N-Lock plug.
13. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. They can be checked by local York distributors.
14. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.
15. If none of the above correct the error, replace the UCB.

Gas Heat Troubleshooting Guide

On calls for heating, the draft motor operates and the furnace lights but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in “AUTO” position).

⚠WARNING

The furnace may shut down on a high temperature condition during the procedure. If this occurs, the UCB energize the supply air blower motor until the high temperature limit has reset. Caution should be used at all times as the supply air blower may energize regardless of the room thermostat fan switch position.

1. Place the thermostat fan switch in the “ON” position. If the supply air blower motor energizes, go to Step 9.
2. If the supply air blower motor does not energize when the fan switch is set to “ON,” check that line voltage is being supplied to the contacts of the M3 contactor, and that the contactor is pulled in. Check for loose wiring between the contactor and the supply air blower motor.
3. If M3 is pulled in and voltage is supplied at M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on inherent protection. Cancel any thermostat calls and set the fan switch to “AUTO”, wait for the internal overload to reset. Test again when cool.
4. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts is present at M3 but M3 is not pulled in, replace the contactor.
5. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.
6. If 24 volts is not present at M3, check that 24 volts is present at the supply air blower motor terminal on the UCB. If 24 volts is present at the UCB terminal, check for loose wiring between the UCB and M3.
   a. If 24 volts is not present at the UCB supply air blower motor terminal, check for 24 volts from the room thermostat. If 24 volts is not present from the room thermostat, check for the following:
      - Proper operation of the room thermostat (contact between R and G with the fan switch in the “ON” position and in the “AUTO” position during operation calls.)
      - Proper wiring between the room thermostat and the UCB, and
      - Loose wiring from the room thermostat to the UCB
7. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
8. If the thermostat and UCB are properly wired, replace the UCB.
9. If the blower motor runs with the fan switch in the “ON” position but does not run shortly after the furnace has ignited when the fan switch is in the “AUTO” position, check the room thermostat for contact between R and G during “W1” calls.

On calls for heating, the supply air blower operates but the draft motor does not (the room thermostat fan switch is in the “AUTO” position).

1. The draft motor has inherent protection. If the motor shell is hot to the touch, wait for the internal overload to reset.
2. If the motor shell is cold with the room thermostat calling for heat, check for line voltage at the motor leads. If line voltage is present, replace the draft motor.
3. If line voltage is not present, check for line voltage on the ignition control at the “inducer” terminal draft motor relay (DMR or DMC) contacts in the main control box and check to see if the (DMR or DMC) is pulled in.

The draft motor runs but the furnace does not light and the spark ignitor does not spark.

1. Check for 24 volts at the spark ignitor from the ignition control board (ICB). Check the 24-volt wiring from the ICB to the spark ignitor. Check for 24 volts at the ICB spark ignitor terminal.
2. Check the ground wiring for the ICB and the gas valve is intact and making good electrical connection. Check the ceramic insulator on the spark ignitor for breaks or cracks. Replace the spark ignitor if damaged.
3. With the draft motor running, check for 24 volts at the pressure switch terminal on the ICB. If not present, check for 24 volts on the terminal from the pressure switch. If present, go to step 4. If 24 volts is not present, the either pressure or rollout switch is not closed. Or the draft motor is not sufficiently evacuating the heat exchanger tubes or the pressure switch has failed. Check the operation of the pressure switch. Check the line voltage to the unit; if line voltage is low, call the local power company. If the problem persists, the draft motor may need replacement.
4. If the furnace is hot, it may be out on a high temperature limit open; wait for limit reset.
5. If all are intact replace the ICB.

The draft motor runs and the spark ignitor sparks at the burner, but the burner does not ignite and a gas odor is not detected at the draft motor outlet.

1. Check to ensure gas is being supplied to the unit. Confirm that the gas pressure to the unit is within the proper limits as described in the “POST START CHECKLIST”.
2. Check the voltage at the gas valve and at the gas valve terminals on the ICB. Check all wiring between the ICB and the gas valve. Check to make sure the ground connections are intact.
3. If 24 volts is present, remove the pilot burner and the orifice. The removal procedure is described in “BURNER/ ORIFICE INSPECTION/SERVICING.” Inspect the orifice for obstruction. If it is clear, replace the gas valve.

Main burners light but exhibit erratic flame characteristics.

1. Check the main burner orifices for obstruction and alignment. The removal procedure is described in “BURNER/ORIFICE INSPECTION/SERVICING”. Clean or replace burner orifices and burners as needed.

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